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THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

On various occasions since the promotion of this so-called International Exhibition, we have found it necessary to comment in no favourable terms upon the arrangements made by those in authority, and to express our dissatisfaction as to the evident purpose of the said exhibition.

We find it necessary to again call attention to a more serious matter which has caused a wide-spread discontent amongst the exhibitors themselves. This is, however, at present chiefly confined to those interested in telephones, and we need not remind our readers that many minor exhibitors are, and have been for some time, endeavouring to break down the monopoly in telephones now possessed by the telephone companies holding the Bell and Edison patents. The grievance, however, amongst these minor exhibitors is of such an important character, that a deputation* has been sent to meet the directors of the Crystal Palace on behalf of several firms. It appears that some of their number have had their apparatus tampered with, and this has gone so far as the destroying of battery cells, by pouring into them various destructive chemicals, breaking transmitters, and cutting wires. Of course it is difficult to detect the perpetrators of these rascally deeds, and it behoves the Crystal Palace authorities to exercise every effort to discover the authors of such outrages. An impression seems to prevail amongst those most interested, that if not actually countenanced by certain of those presiding over this exhibition, the matter has not been met with that promptness the circumstances call for; certainly the necessary steps for the protection of exhibits have not apparently been taken. In addition to these outrages, we are told that the exhibitors who are now seeking redress at the hands of the Palace directors have been obliged to put up with great discourtesy and restrictions from which others have been free. Amongst other drawbacks they have not been allowed to use their wires in connection with any rooms wherein music is performed, the telephone concerts for the delectation of the public being exclusively devoted to the above-mentioned company.

They have been told that they are all infringers of the Bell and Edison patents, and it has been hinted that it would be well if they withdrew, and left the Company holding the above patents in sole possession of the ground. This being probably what is wished for, it is hardly likely that it will be done without a struggle. If these minor exhibitors are infringers of the Bell and Edison patents, which however must first of all be proved in England, why was not this pointed out to them at the beginning. Perhaps Major Flood Page (who is, we believe, the responsible manager of everything in connection with this exhibit) would say that he did not know at the time that the alleged infringements existed. Be this as it may, it is a most unsatisfactory state of affairs that an exhibitor is afraid or disinclined to complete the appointments of his stall, lest his apparatus should be injured or partially destroyed. We believe that it is the expressed intention of these gentlemen, should their deputation fail to get a satisfactory guarantee of protection from the Palace directors, to withdraw their exhibits from Sydenham. We however think that it would first be advisable, in case of failure of their endeavours in this direction, to apply to the Honorary Council of Advice, who may have more weight with Major Flood Page than his own directors. We believe that this gentleman, in his arguments with the leaders of the dissatisfied exhibitors, has stated that the company owning the Bell and Edison patents has threatened, or might threaten, the Crystal Palace Company with an injunction restraining these exhibitors from showing their apparatus, on the ground that they are all infringers of its patents. The complainers apparently think that as long as any apparatus (whether an infringement of a patent or not) is merely exhibited and not sold, an injunction could not be granted. This however we believe is a mistake, for as the whole exhibition is a means of making money for the Crystal Palace, the directors could be held liable if any part of their show consisted of proved piracies of genuine inventions.

Should such an injunction be applied for, the exhibitors could even then, should they choose so to do, take upon themselves the responsibilities in connection therewith. Apparently as far as the position of their stands in the Exhibition is concerned, it is almost worthless. During the day it appears that few people visit the galleries, and up to the present these have not been illuminated at night. There is no doubt that many others than those we have been commenting upon are not at all pleased with the status of the Exhibition. The great *International* Exhibition of Electricity at the Crystal Palace, which was to be far beyond anything seen in Paris, and which in the daily advertisements is curiously mixed up with the Crystal Palace pantomime and other attractions, seems scarcely likely to become even a representative national one; and certainly if *bonâ fide* exhibitors, after taking a vast amount of trouble, and spending a considerable sum of money in fitting up their stalls for the benefit of the public, are subjected to slights, restrictions, and wilful damage, the Exhibition will decrease considerably as far as numbers are concerned, and it will doubtless eventually be confined to a few privileged companies and individuals, and therefore resolve itself into what was by some foreseen from th first.

We can justifiably repeat here the conclusion of our article on the Crystal Palace Exhibition in our issue of November 15th, and which reads as follows:—"We doubt not that thus far the exhibition will answer the purport of the Crystal Palace directors, but we can only regret that those gentlemen who have nominally been asked to advise the directors had not been invited to do so before the programme had been definitely laid down, so that an electrical display with the *widest possible scope* and interest might have been held, and not one limited by the main desire to attract so many thousands of the British public at one shilling admission. For it must be borne in mind that by having

* This is referred to in another column.

an exhibition of the kind, all too soon and under such conditions, it must militate against the chances of holding one even more perfect than that of Paris later on; and, moreover, which might have found, and we hope will find, a temporary home in the more congenial surroundings (from a scientific point of view) of South Kensington Should this hope be consummated, we trust the arrangements will be directed from their commencement by gentlemen interested truly for the advancement of electrical science, and in scientific and technical education. Originating with such promoters, the affair will be above the suspicion of other than high-class aims, and the promoters cannot well afterwards be placed in the position of effigies only intended to move when the wires are pulled by those who look only for their own special advantage in getting up the show. . . . But the more we hear of the method of conducting the whole arrangements, the more are we enlightened as to its non-scientific aim, and as to the nature of the advantages of such an exhibition to the electrical profession."

A CHEAP FORM OF VOLTAIC BATTERY.*

By ALFRED R. BENNETT, M.S.T.E. & E., Engineer to Messrs. D. & G. Graham, Glasgow.

IN these days of dynamo and magneto-electric machines and accumulators, voltaic batteries may seem old-fashioned and out of place, but they have, nevertheless, functions of their own, such as the supply of electricity for domestic purposes, for telegraphy and telephony, which possess sufficient importance to render any improvement or economy effected in their construction worthy of note. The author trusts that this consideration will be deemed a sufficient excuse for bringing before the Philosophical Society of Glasgow the details of a new and exceedingly cheap form of voltaic battery lately devised by him.

The object he had in view was to discover a combination capable of performing at less cost the duties at present so admirably fulfilled by the Leclanché battery. Although the new form has not yet undergone the crucial test of prolonged trial in actual service, yet for some months it has been subjected to severe tests side by side with the Leclanché, and has not shown any evidence of inferiority, either as regards power or durability.

The idea of the combination was suggested by the well-known fact that iron will not rust in solutions of the caustic alkalis, a fact probably due to the non-existence in such solutions of free oxygen and free carbonic acid. It was argued from this that if a plate of iron and a plate of zinc were immersed in such a solution, the iron not being attackable by the alkali would be strongly electro-negative to the zinc. Trial proved the idea to be strictly correct, not only iron, but nickel and cobalt, as well as gold and silver, and the metals of the platinum group, were found to be practically as electro-negative to zinc as carbon itself. Carbon is at first a little more strongly electro-negative than iron, but, owing to the absorption of hydrogen in its pores as soon as the circuit is closed, it is in practice in nowise superior. Silver is the most electro-negative of all the metals in these solutions. The use of iron, if practicable, has obviously several advantages. The cheapness of the metal and its freedom from liability to fracture as compared with carbon are strong points in its favour, and it affords besides the possibility of making a perfect and permanent connection on the negative plate for the binding screw, an end so difficult to attain when carbon is used. It was discovered, however, that a simple iron plate polarised very rapidly, the hydrogen set free by the action of the battery clinging to it and greatly increasing the resistance. By surrounding the plate with a packing of small fragments of iron, such as clean turnings or borings, in the same manner as the carbon plate in the original type of Leclanché, is surrounded by fragments of carbon and manganese dioxide, this deleterious action is considerably modified, and the cell acquires to a great extent the power of keeping up its electromotive force when working continuously through a low external resistance. The number of points presented by the turnings or borings is probably the cause of this, as it is well known that hydrogen escapes with much greater freedom from a rough than from a smooth surface. The packing of iron fragments is, in fact, the platinised silver plate of Smee in another form. The greatest efficiency is obtained when the iron fragments are thoroughly damped by the solution, but not immersed in it, the obstacles to the escape of the hydrogen being then at their minimum. Although not quite constant when working through an external resistance of 20 ohms, the battery recovers its original electromotive force when allowed to rest with a rapidity sufficient to allow of its employment on the busiest telegraphic circuits and for most other practical purposes. The electromotive force of the iron battery varies somewhat with the nature of the iron and the purity of the exciting salt employed. Also with the degree to which the iron fragments are saturated or covered by the solution. The Daniell being 1 and the Leclanché at its best 1·30, the iron varies from 1·15 to 1·33. The last was an exceptionally good cell, and the average may be taken at 1·23, or ·07 less than the best Leclanché. But after working for some days continuously through a low external resistance, the iron keeps up its electromotive force much better than the Leclanché. This was proved lately, at the suggestion of Mr. David Graham, who thought it likely to demonstrate the comparative capacities of the two batteries for actual work by setting a good specimen of each cell to ring an electro-magnetic trembling bell of precisely similar construction, and each of a resistance of 5 ohms, day and night until they failed. They were started at 11·10 a.m. on December 23rd last. After four or five days the Leclanché became very weak, and although it did not actually stop until January 12th, it latterly simply vibrated the hammer of the bell without striking the gong. The iron cell rang the bell powerfully until January 15th, and did not stop until January 23rd, exactly one month, or 744 hours, from the date of starting.

The chemical reaction of the iron battery is probably as follows (there being present when a solution of potassium hydroxide is used):—

$$Zn_2 + KHO + H_2O + Fe,$$

the closing of the circuit produces first,

$$2\,ZnO + K + H_3 + Fe.$$

That is to say, at the positive plate the oxygen of the potassium hydroxide and of the water is given off, and combines with two atoms of zinc to form zinc oxide. At the negative plate, the potassium and the hydrogen of the potassium hydroxide, and the hydrogen of the water are set free. The metallic potassium instantly decomposes an additional molecule of water in the negative portion of the cell, with the oxygen of which and with one of the free atoms of hydrogen it combines to re-form potassium hydroxide, leaving the four atoms of hydrogen due to the decomposition of water free. This makes the final stage,

$$2\,ZnO + KHO + H_4 + Fe.$$

The caustic solution is consequently used up in the positive half of the battery and re-formed in the negative. It is to the polarising action of the free hydrogen that the inconstancy of the electromotive force is due. It however, as has already been stated, ascends between the iron fragments and rapidly escapes to the air. The author has attempted in many different ways to get rid of this obnoxious gas, but without permanent success. Mixing platinum black with the iron packing answers to some extent for a time, as the platinum absorbs the gas and leaves the iron free. Another plan is to place a chemical having a great affinity for oxygen, such as pyrogallic acid, nitrate of cobalt, permanganate of potassium or sodium at the negative plate. But the chemicals which absorb oxygen with sufficient avidity have little permanency and soon cease to act. The presence of a per-

* Extract from Paper read before the Philosophical Society of Glasgow on Feb. 1.

manganate raises the electromotive force of the battery in addition to improving its constancy, but the effect is transient. A cell was placed in a jar of oxygen in hopes that this gas would find its way through the iron packing and combine with the hydrogen to form water. But the hydrogen would have nothing to say to the oxygen until it was clear of the battery. It then combined, and the cell being kept at work was in a couple of weeks drowned in water of its own creating. These are, however, at best complications which, besides being superfluous, are inadmissible on the score of expense in a cheap battery, which the one under consideration is specially designed to be. Its cheapness and the ease with which it can be made up are, indeed, its most remarkable features. There is here an old tinned iron can, which, as the legend upon it distinctly states, was originally packed with corned beef in Chicago. At that time there was little probability, it is to be presumed, of its making its appearance before such a learned assembly as the present. The beef having been consumed in Glasgow by some of Her Majesty's lieges, now unknown, the can was cast aside as useless, and was acquired without much difficult or prolonged negotiation by the firm of Messrs. D. and G. Graham for the sum of one farthing sterling. There is also here a quantity of iron borings swept from the floor of an engineer's workshop, the cost being simply the time and trouble consumed in sweeping. There is also a strip of common zinc, cut from an old roof ventilator, a porous cell, and a bottle containing a solution of 4 oz. of commercial potassium hydroxide. The porous cell being placed in the tinned iron can and packed with borings, the solution is poured in, and the zinc strip immersed in it.

The tendency of the caustic alkalis to absorb carbonic acid from the air renders it desirable, although not absolutely necessary, to keep the porous cell which contains the solution tightly covered. On the other hand, the iron portion of the battery should be exposed as freely to the air as possible, to facilitate the escape of the hydrogen. These contrary conditions are rather vexatious, but by no means impossible of attainment. The most practicable mode of solving the difficulty appears to be the placing of the positive portion of the combination in an earthenware cell about 7 inches in height, but porous only for 4 inches from its bottom, which porous cell is fitted with an air-tight stopper, through which the zinc rod is brought and terminated by a binding screw. The earthenware cell is placed in an iron can 5 inches in height and of a like diameter, and packed in firmly with turnings or borings. The earthenware cell, having been filled with solution almost to overflowing, the air-tight stopper is fitted in, and the battery is ready for use. The advantages of this arrangement are the exclusion of carbonic acid from the caustic solution, while the iron is left exposed to the air; the prevention of evaporation, and the preservation of the packing from too profuse a wetting. There being no air pressure on the surface of the solution in the earthenware cell it can only percolate with extreme slowness, being opposed by the pressure of the air acting through the iron borings and the pores of the cell. The presence of carbonic acid in ordinary water renders it desirable to make the solution with distilled or newly-boiled water. If this is done, and the cell instantly closed with an air-tight stopper, the conditions necessary to secure the best results have been complied with. Instead of distilled or boiled, common water may be used if a portion of newly-slaked lime is added to the solution before closing the cell. For ordinary purposes, however, these precautions may be dispensed with.

Now, as to the cost: the tinned iron can may be used without detriment. The tin, being strongly electro-positive to iron, sets up a local action with the borings as soon as the solution reaches it, and, being small in quantity, is soon resolved into tin oxide without injury to the battery. The soldered joints of American preserve cans are but very little affected by the solution, and can be depended upon not to leak if tight in the first instance. Solders in which tin or zinc are present ought to be attacked, but copper and lead are but little acted upon. The joints of such cans are probably so carefully made in the first instance as to be mostly water-tight without the aid of solder. These cans may therefore be regarded as perfectly efficient although so ridiculously cheap. The cost of one, including the borings, which are by no means scarce in Glasgow, may safely be put down at one farthing. The borings never need renewal, as they do not rust and are not changed in any way by the action of the battery. The zinc may be of the commonest kind as no local action of importance has been observed unless the caustic used is very impure. Amalgamation is therefore useless. Strips of common roofing zinc rolled into cylinders answer perfectly well. The porous cell is the most expensive item, but this can be dispensed with by the use of diaphragms of canvas or other fabric of vegetable origin. It must be remembered that the caustic alkalis destroy all animal tissues, so leather, bladders, &c., are not admissible. The author has tried cells of thin wood, such as willow boxes, with success; but the earthenware is more permanent, and, in spite of its prime cost, probably the most satisfactory in the end. Such as the one before you can be procured wholesale at 2d. each. A diaphragm of some kind is absolutely necessary. Caustic soda, in a state of reasonable purity, is made in the neighbourhood of Glasgow, and can be obtained wholesale at a little over a 1d. per lb. Whether this is sufficiently pure for long continued action has, however, yet to be determined. To sum up the cost of one cell in its simplest form, we have:—

	D.
Can and borings	¼
Porous cell	2
Zinc, say	1
Soda, 4 oz.	½
Soldered wires for connections... ...	1
Labour	1¼
Total ...	6d.

which is quite a liberal allowance.

The battery is, consequently, probably the cheapest ever devised in proportion to its power and durability, when regarded in the light of prime cost, but it becomes even cheaper when it is considered that the chief product of its action is zinc oxide, known in the paint trade as zinc white, which is extensively used as a pigment, and as a substitute for white lead generally. It can easily be recovered in an approximately pure state from the used-up battery. From the cell which rang the bell for a month 1,458 grains, or 3·04 oz. troy, were recovered, the zinc consumed being 1170·7 grains, or 2·44 oz. troy. Some of it—one-sixth of the quantity recovered—is on the table before you. Its price in the market ranges from 6d. to 1s. 6d. per lb., according to purity. As this is by no means a bad example, containing only a very slight trace of iron, its value exceeds that of the zinc consumed. It has been said that voltaic batteries can never compete with dynamo machines, because the zinc used takes coal to reduce it from its ores to the metallic state, which coal would have produced the energy direct if burned in the furnace of a steam-engine driving a dynamo. But if the product of the consumption of zinc in a voltaic battery can be made to defray the cost of the zinc, that oft-quoted argument somewhat loses its force. However that may be, it is pretty evident that the man who can buy, borrow, or —— otherwise become possessed of a few old preserve cans, a corresponding number of porous cells, a quantity of iron borings, with a few pounds of caustic potash or soda, and who has an old zinc chimney to cut up, can conjure up and render subservient to his wants or his pleasure in many ways that mysterious but beneficent force which we know as electricity. He may, perhaps, even light his library on a small scale, or drive his wife's sewing-machine; and, after all, when the battery ceases to work, he can take it to pieces and paint his house, or a part of it, with the products.

The battery, however, need not be made cheaply. It lends itself with equal facility to the taste of the sybarite as to the means of the working man. As before stated, nickel, cobalt, silver, gold, platinum, are all strongly electro-negative to zinc in caustic alkalies, and might all be used to good purpose. A golden goblet packed with half sovereigns, instead of a tinned can packed with iron borings, would ring an electric bell or work a telephone admirably; as would also a silver chalice packed with sixpences. So it is obvious that refinement is possible in voltaic batteries, as in everything else. It may be noted that copper also answers well instead of iron for a time, but a soluble salt of copper is gradually formed, which is precipitated upon, and stops the

action of, the zinc. On the table are various forms of the battery. In some, the negative plate, consisting of an old file, an old knife, or a spiral of iron wire, is packed with the borings in a porous cell, the positive portion of the battery in such cases being in a glass or earthenware jar.

LEGISLATION FOR CABLE PROPERTY.

WE notice that the *Journal Télégraphique* of Berne, which is published by the International Bureau of the Telegraph Administrations, has in its last number taken considerable notice of the petition of the companies to the Foreign Office and to the Board of Trade.

While discussing this petition and the reply from the Board of Trade, they refer at some length to our first article, written under the above heading, on the right of first comers.

It is needless to say that when this discussion is entered into by the Bureau International des Administrations Télégraphiques, there is some hope that the governments interested may bring about an international legislation which will remedy the present unsatisfactory state of things, having due regard to the interests of fishermen and navigators.

That these interests should be looked after is a necessity, in face of the strong influence of those who practically rule the telegraph world.

In *l'Electricité* of the 28th ult., we find some exceptions to our proposition, that the laying of a submarine cable over a strip of ground should entail the proprietorship of that ground. The argument used in that journal is, that this proprietorship would practically hinder any new line from crossing or from being laid in the vicinity of the said cable.

To meet this difficulty, we have already suggested that a fair indemnity, paid to the first comer, would give the new line full right to cross or to lie close to the original line. The settlement of this indemnity would not appear to present insuperable difficulties, as in ordinary life the payment of indemnity for vested interests is well understood. That *l'Electricité* has touched on a vital point there is no doubt, but we would look at the question from the opposite side to that taken by our contemporary.

In discussing this particular point, let us take for example a most notable case, viz., the cable about to be laid between Valentia and Greetsiel, near Emden.

With the exception of the probable crossings of the shore ends of the Atlantic cables, starting from Valentia, this new line will be laid over—

1.—2 cables, commonly known as Jay-Gould's lines.
2.—1 ,, from Porthcurnow to Vigo; Eastern Telegraph Co.
3.—1 ,, ,, to Lisbon ,,
4.—1 ,, ,, to Brest; Pouyer Quertier Cable.
5.—1 ,, Lizard to Bilbao; Direct Spanish Telegraph Company.
6.—1 ,, Salcombe Bay to Brest; Anglo-American Company, French cable.
7.—1 ,, Dartmouth to Jersey; English Government.
8.—1 ,, Beachyhead to Havre; Submarine Telegraph Company.
9.—1 ,, ,, to Dieppe ,,
10.—1 ,, Dover to Boulogne ,,
11.—1 ,, ,, to Calais ,,
12.—1 ,, ,, to Lapanne ,,
13.—1 ,, Ramsgate to Ostend ,,
14.—2 ,, Lowestoft-to Zandvoort; English Government.
15.—1 ,, ,, to Greetsiel; German Union Company.
16.—1 ,, ,, to Norderney; English Government.
17.—1 ,, Calais to Fano (Denmark); Gt. Northern Telegraph Co.

Or, in all, 19 cables, having a total of some 58 conductors.

The new cable will therefore cross 19 other cables; and, considering that the laying of the new line renders to a certain extent more difficult the maintenance of the pre-existing 19 cables, it would seem most unjust that the owners of these 58 conductors should receive no indemnity from those who have the option of laying the new line. Let us consider the impossibility of repairing at the crossings either of the lines of the first comers, without allowing a margin on each side of the new line of not less than one mile. We have practically damage done to at least two miles of each of the above lines, or—say, thirty-eight miles in all. Taking the cost of replacing thirty-eight miles of cable of—say, three conductors each, we shall find this represents a sum of about £17,000. If some of the gentlemen connected with this new line would remember that charity begins at home, they would redress this evil, which is in their power, and would not be so severe on that which, in most cases, is inadvertent damage done to their cables by fishermen and navigators.

That some legislation, recognising the rights of first comers is necessary no one can doubt, and we may safely say that the management of the Submarine Telegraph Company would have felt more secure if, during the late cable-repairing operations in the North Sea they had known that whatever might betide their cables the indemnity paid to them or to the English Government as first comers would at least be a safeguard against the consequences of possible damage, occurring unavoidably, through the proximity of a later comer, which was then, and is now, so far as we know, under repair.

A contemporary in one of its late numbers, in connection with the subject of cable legislation, asked the following questions :—

"Did the said companies (referring in this to the list we have given above) indemnify the fishermen, and, if so, what fishermen? And, further, by what right the fisherman were recognised as first comers?"

We would point out to the said contemporary that in our article of the 15th December last, we said: "We would *suggest* that the attainment of the above object might be greatly assisted if laws were passed to enforce in the first instance a respect for the rights of 'first comers' to a cable ground." Nevertheless, answers to the said queries might be given as follows:—Although no direct indemnity has been paid to the fishermen, yet the large amounts expended in repairing damages done by them have probably exceeded the amount of such indemnity. These sums would in all probability have been saved had the companies, by paying an indemnity, secured the entire proprietorship of the bottom over which their cables were laid. As regards the right by which the fishermen should be recognised as first comers, the continual interruptions of the cables laid over their grounds, and for which the companies, owning these lines, can obtain no legal redress, is in itself a proof of their right to the ground. We consider the right of first comers as even more than what is known as a squatter's right in the colonies; it is the right of the first human being who places his foot on land belonging to no private individual nor under the flag of any nation.

We notice in the *Times* of the 13th inst. that a letter has been forwarded by the principal telegraph companies to the Board of Trade. From the general tenor of this letter one would believe that the telegraph companies are wronged by fishermen and others interrupting cables which are properly marked on existing Admiralty charts. As a matter of fact, the Admiralty charts bear few tracks of cables, and, in most cases, these tracks are only approximately correct.

In analysing the signatories to the petition to the Board of Trade, we don't see very clearly what hardship the majority of the companies undergo in the North Sea. It is no doubt very kind of some of the deep sea companies trying to aid the English Government, the Submarine Telegraph Company, the Great Northern Telegraph Company, and the German Union Telegraph Company, who are, we believe, the only proprietors of cables in these waters. Why the Eastern Telegraph Company, the Eastern Extension China and Australasian Telegraph Company, &c., should take such a prominent place in the matter is difficult to understand, unless they are possessed of some hidden philanthropy for which we have not hitherto given them credit. In contradistinction the West Coast of America Telegraph Company did not think it necessary to ask the Foreign Secretary to legislate principally for telegraph property in the North Sea.

The exceedingly just claim put forward by ourselves, that all telegraph vessels should be considered, so far as the custom house formalities are concerned, on the same footing as government vessels, has been somewhat baulked by the penny wise petition that these vessels be exempted from light and harbour dues.

The light and harbour dues are, comparatively speaking, a small item, when compared with the necessity of a quick despatch; and we are afraid that, through the companies claiming to be freed of charges for benefits (such as lights) conferred on them, they would appear to desire to make themselves a burden to the ports they enter.

Our claim is, that though these charges should be paid,

yet cable vessels should be exempted, so far as it is possible, from the tedious formalities often connected with paying a small sum of money.

The following is the substance of the letter addressed by the submarine telegraph companies to the Board of Trade, through Mr. Pender, M.P., in which they suggest the enactment of the following provisions for the protection of submarine cables :—

1. That submarine cables should be entitled to protection against negligent or intentional injury wherever occasioned, and that the damages recovered should be exemplary whenever the injury done should be unnecessary and wilful.

2. That vessels should be directed not to anchor within—say, one mile of the line of a submarine cable as laid down by the charts, unless in case of necessity, caused by stress of weather or other sufficient cause, and that in the event of ships so anchoring and fouling the cables, stringent precautions should be observed in recovering the anchor.

3. That the companies should be bound to make good the loss of anchors, chains, and other gear when *bonâ fide* sacrificed to prevent damage to telegraph cables.

4. That vessels and fishing boats should be compelled to keep clear of steamers and buoys employed in laying and repairing submarine cables.

5. That in respect of the use of trawls improperly repaired and unduly dangerous to cables, a right of inspecting trawls and of requiring that they should not have projecting and ragged pieces should be vested in the customs or coastguard, or other local authorities. The mere fact that Government had established such an inspection would, in the belief of the companies, greatly diminish the number of injuries of this character.

6. That trawlers should be directed to act with caution while dragging across ground where cables are known to lie, and that in case of fouling the cables the same regulation should be observed as above suggested in case of anchoring and fouling.

7. That all vessels and fishing craft should be liable in damages wherever negligent or intentional injury to submarine cables, telegraph buoys, and other laying or repairing gear can be proved against them.

8. The companies might be required to publish in a sufficient manner by notices at all custom-houses, coastguard stations, or other centres of nautical and fishing resort, particulars of the course and direction of their cables, and to afford to the hydrographical offices the same information to be embodied in their charts.

9. An additional clause would provide for the exclusive jurisdiction of the Admiralty Courts.

The mere enactment of such protective laws would, the companies believe, prove a substantial check upon the ruthless indifference with which submarine cable property is at present treated. They disclaim any intention to restrict the freedom of anchorage in any case where the safety of the vessel might be imperilled. All they desire is the prevention of negligent anchorage in the vicinity of cables in cases where such anchorage is in no way essential; and no actual prohibition is sought even in this respect.

The companies would not object to incurring the responsibility of compensating vessels for the loss of cables or anchors which might be abandoned in order to avoid a cutting of the telegraph cable.

The furnishing of evidence as to the destruction of cables appears to the companies "not to offer the difficulties which the Board of Trade seem to consider almost insuperable. One of the first measures adopted by the companies would doubtless be the offer of a liberal reward for information, and it is contrary to all received experience that this would fail of effect. The possibility of information being furnished would of itself act as a powerful deterrent, and one or two cases of recovery of damages would operate still more decidedly in the same direction."

The companies express their regret that the Board of Trade have yet seen no reason for exempting vessels actually engaged in cable-laying and cable-repairing from the payment of light and harbour dues paid by other vessels. Their vessels are not unfrequently in and out of harbour half-a-dozen times or more before the repairs are effected, especially when in proximity to the coast of England and Europe; and in many cases are repeatedly driven into these harbours by stress of weather, and thus compelled to incur a repetition of the charges for light and harbour dues.

THE UNITED TELEPHONE CO. *v.* F. POPE COX.

THE United Telephone Company applied on Tuesday last for two months' further extension of time for the purpose of replying to the defence of Mr. Pope Cox on his alleged infringement of their patents. This gentleman opposed their application, but they were, however, allowed ten days longer. We believe that Mr. Pope Cox's defence has already been before the company for some months, so this extension of time seems to be hardly called for. In the counter action of Pope Cox *v.* The United Telephone Company for damages, the company's defence has not yet been put in, and they have, we hear, made more than one application for extra time.

THE TELEPHONE CASE.

(*Continued from page* 106.)

LORD M'LAREN: That cork diaphragm, when it is pressed back, passes entirely across the chamber, so that no air can pass from the mouth into the inner chamber. The impulse is there, but the air set in motion by the speaker can only pass into the interior of the box either through its walls or through the chord.

LORD ADVOCATE: That is so.

LORD M'LAREN: There is no free passage to or from the external air into the box?

LORD ADVOCATE: None; and accordingly it is true that if you set up a telephonic action it is a common quality; but then, my lord, I think we got more of reason and sense from poor Mr. Blyth to-day than from Mr. Cooke. That was what Theiler intended, that the current is made to vary by the vibrations of the diaphragm or sounding board. Yet Mr. Cooke came into the witness-box, and said of the Theiler apparatus that it was perfectly immaterial whether you had a diaphragm at all, whereas Theiler says he gets his variations by the vibration of the diaphragm or sounding-board. Theiler quite disagrees with Conrad Cooke in all his opinions about rattling and jolting. Theiler says it is by the pressure, so that if you take the description of Theiler and the description of Edison you cannot distinguish them, and so Cooke accepted the bold idea that Theiler did not understand his own instrument. He had to admit also that Hughes did not understand his. Hughes speaks of contact and intimacy of contact. He attributes the virtue in the telephone, in the past tense, to the pressure, and so does Mr. Theiler. But Mr. Cooke says both the inventor and the infringer are wrong. He need not have his diaphragm, or mouthpiece, or cork. And I would ask your lordship whether for a moment you could take that, rejecting the description of Theiler, the provisional patentee, Hughes—we will call him the inventor of the microphone, though we do not admit the title. They have reduced themselves to a state of philosophical doubt about this matter. They do not say there is any certainty. They come and claim their ignorance as a virtue, and ask your lordship to proceed on their ignorance, and just to reject the opinion of those who invented them—Hughes and Theiler. It is the extremest shift to which an infringer is put to get a witness to come and say, and I am not surprised he only got one to say it, that he may have dispensed with all the most vital parts of his instrument when everybody knows he cannot. What are the two opposing theories then? What I have said up to this point is the comparison of the instrument, of the look of the instrument. It may be that there is an occult action in the one which is not in the other, but I venture to think they look uncommonly alike, and when you find that the vocal impulses strike the diaphragm, are connected through the cork to two pieces of carbon, that these are compressed against a third, and when you find that that varies the resistance and that everything else in the two instruments is the same—the batteries, the local circuit, the close circuit, and everything else—it would be a very singular thing if one were to go now and seek for a distinction when the phenomena are identical, and that is all we can go on in questions of this kind. Will your lordship accept a suggestion of admitted ignorance or of possible difference against a fact? Mr. Edison's patent is not for a theory, not for an explanation of a mode of bringing it about. If Mr. Edison had patented a principle he would have patented what he had no business to patent. It would have been a bad patent. But what he has patented is certain methods and modes of producing a certain result—the same result produced in the same means as that employed in this instrument of Theiler. But an attempt is made to pin him down to compression in the mass by reference to certain passages in the specification. Referring first to his own description of the patent, he says that in his present invention he makes use of the vibrations given to the diaphragm or tympan by speaking into a resonant case to produce a rise and fall with such accuracy as would respond to the tones of the voice. He then gives the general features of number thirty-five, in which he says that "the general features thus described pervaded my entire invention, but in developing the same many useful modifications and variations have been made which I will proceed to set forth." My friends find nothing to limit me down to that; where they do think they find something to limit me is in the particular modifications which he afterwards describes. I think, my lord, that where they first seek to get the limitation to compression is on pages 5—20. The resistance may be produced in various ways. He does not limit himself to a particular way. "I have shown several which will be hereafter named, but I find the most delicate to be simply bunches or tufts or discs of fibre. This device I call electric tension regulator, and it is more or less compressed according to the vibrations of the diaphragm." If you have a bunch of floss silk there is a great deal of space between the threads. If you wish to bring them into contact you squeeze them. The fibre is rendered semi-conductive by being rubbed with plumbago. When you dust silk with plumbago what do you do? You bring carbon particles against carbon particles. When you take up a tuft of silk powdered with plumbago, you simply use the silk as the vehicle for bringing together particles of carbon. This is another way of bringing carbon against carbon, and you get the same phenomena from the two. Why should you say that there is a different mode of action or *rationale* in the two cases? Then on p. 6 Mr. Edison says that in some cases he makes use of variable resistance resulting from greater or less intimacy of surface contact. You may do it by covering with plumbago the disc, and bringing it into contact with the diaphragm also covered with plumbago, and then he goes on to say that he will show three or four modifications of the arrangement. Mr. Conrad Cooke and Mr. Blyth could not help admitting that this did not express the method of producing density in the mass, because there is no mass. It is objected that we are not told to what extent the discs are covered with plumbago. I do not care. They cannot dispute that what is here referred to is sur-

face contact, and I care for no better description than that drawn from Mr. Blyth to-day, that intimacy of surface contact is simply produced by bringing more of the particles of a thing into a mathematical plane. But still proximity of contact, and not pressure producing density in the mass, are the things that are specified, and if so then they say there is a limitation upon Edison. Again, they say you have not told us how to do that. I say we have given illustrations of it in many of these drawings, but I do not pause to consider that because I am not dealing with the question whether on the fair construction of Edison's patent he is limiting himself to produce his effects by compression of the mass. And supposing there was an objection on the ground of want of specification of any mode of description, this conclusively showed that he did not limit himself to compression by density of the mass, because he is here working with a case that has no mass.

LORD M'LAREN: If he had been intending to proceed by compression he would have told you what he was to use.

LORD ADVOCATE: Just so; and when he speaks of that being covered with plumbago he evidently shows that all he needs is plumbago particles, in contact with plumbago particles. That is just another way of doing the same thing, which a man does if he powders a tuft of silk with plumbago and then squeezes it. It is just another mode, the silk is but a vehicle for the plumbago, and so in this case the first two methods specified by Edison are no other than this. Therefore the notion, for the purpose of keeping outside the patent for a novel and meritorious invention is to put a limited construction not upon what he claims but upon the *rationale* of his claims as the wrong mode of doing it. Supposing this was a bad specification as not showing how to do the thing, that would not be an answer to the point I make upon it that it demonstrates that he did not limit himself to that, because he is here dealing with plates that have no waste upon them at all. It is most unfortunate for the argument of the respondent in this case that the very first two illustrations of Edison's compression do not involve compression on the mass at all. He says you make use of the best of lamp-black, retained within the case; that again also is the same. They are all the same. What is produced there no doubt is in a more literal sense compression in the mass. But it happens that you have a mass in the Clerac tube. It is a matter whether the particles are loose in the tube and you bring them into contact there, or whether they are powdered on silk, or painted on a disc. In all these cases you are simply bringing the carbon closer. But I take another illustration, and in it for the first time you have compressed plumbago in some form, preferably mixed with gum rubber—but not necessarily—mixed preferably with gum rubber to keep it together. You need not mix it unless you please. At any rate here is the first time you get compressed carbon. Now, my lord, I suppose gas carbon is not liable to rapid decomposition, and therefore I cannot imagine anything that looks more *ejusdem generis*. Just see how it stands. It is here for the first time you get compressed plumbago or compressed carbon, and no doubt that is an illustration of compressed carbon. But what is it really? It is compressed before it is used here, and what for? Merely to put it into a form that it can stand alone, that you do not require to use silk as a vehicle, or to put it on a disc or in a Clerac tube. It is merely to enable it to stand alone, so to speak. Well, then, standing alone what is the difference between it and the other? Therefore suppose that Theiler, instead of using three pencils of gas carbon, had thought fit to use three pencils of compressed plumbago, would he or would he not have been within Edison's patent? I now examine Edison's patent, my lord, for the purpose of seeing wherein there is anything in it to justify limitation of the *rationale* of his patent to work it by pressure of the mass. Now, I say it is a fancy altogether to suppose that it so limits it. I do not know that I need go through much of the specification, but I refer to it for the purpose of inquiring whether it is a just construction of Edison's invention to say that he limits himself only to those cases where he gets variation of resistance by creating increase of density by solid pressure. I am going to show that he does not so limit himself. What is the theory against us here? It was admitted, and could not be disputed by Mr. Blyth, that in Theiler's apparatus the pencils are pushed in. I think that, with great difficulty, we got it quite clearly both from Mr. Blyth and Mr. Cooke that that involved pressure against the pencils, that the pressure against the pencils necessarily involved pressure against the horizontal cross pencil, and that that pressure would go on increasing the surface contact of these carbons against carbon until it become so great as to overcome the inertia of the cross piece, and push it away. But, then, my lord, the cross piece is so heavy that it would not be easy to kick it away. It will go away gently, and come back gently, like a spring. Mr. Blyth said that that was exactly what is described on page 6; you are getting a greater or less extent of surface contact between the carbons.

MR. MACKINTOSH: He said nothing of that kind.

HIS LORDSHIP: What Mr. Blyth said in cross-examination was not very clear. He allowed that there was some surface contact, but I do not think he gave that as his explanation.

LORD ADVOCATE: No, my lord. He then resorts to his ignorance as Mr. Cooke does, too. Mr. Blyth admitted that the very things would happen which are described here. There is admittedly an increase of surface contact, and it was also admitted by Mr. Blyth and Mr. Cooke that there is a certain degree of pressure in the mass. They admit, too, in so far as there is elasticity this result would follow, and they could not dispute, therefore, that the resistance occurred and that the resistance is varied. Now, I am quite aware that they both say they think that besides this something else happens. Where does Mr. Edison say that besides this something else may happen? He merely describes the apparatus. He does not say that some force unknown to anybody may not be helping him as it helps them. Like a sensible patentee, he states the results. Is it anything against a man to say that whilst he operates by certain means there may be something else operating with him and also with Theiler, although they do not know what it is? They attempt to reject the notion that it is pressure, then they attempt by an operation of this kind to say that operation is not helping them. What we always speak of is pressure at the point of contact, and Mr. Blyth admitted that pressure at the point of contact does affect resistance. Of course nobody supposes that you can squeeze a pencil or piece of carbon as you can squeeze a quantity of powder. But still even what these gentlemen said does not go to show that there is not some unknown mode of operating in their case, although they cannot find it. When you come to examine this matter, in which all the witnesses for the pursuer have deposed, and they are men of the highest eminence, and then when you examine that of the two for the defender, you cannot but come to the conclusion that the mode of action and mechanism are identical.

The Court then adjourned till Saturday morning.

SATURDAY, 28th.—On assembling, LORD M'LAREN, addressing the Lord Advocate, said: You were speaking last, Lord Advocate, with regard to the transmitter and its mode of action. In reference to the objections that have been indicated, I do not think you had said much upon the material used. I infer from the evidence that one of the objections to the specification was that it did not indicate the right material, that there might be other materials quite as good as carbon, that in fact there was no special merit in carbon, which seemed to be the only substance indicated in the specification.

LORD ADVOCATE: I had rather thought it had been that I did not indicate the whole range of carbons, because carbon is common to both of us, as it happens.

LORD M'LAREN: He does not limit himself to carbon but "semi-conducting material" is a term used, and I think that the only one of the witnesses who spoke to that was Sir William Thomson, who, in answer to a question put by myself, said he thought it was a perfectly correct description of the materials that were useful in that connection that a good conductor would not answer, because it would too readily transmit the electric forces even through a very small proportion of surface; but that the semi-conductor was the proper kind of conducting material to make the circuit readily responsive to the variations of surface.

LORD ADVOCATE: Yes, my lord, but I think I have almost finished with that, at least. I do not propose to take the opportunity of reviving the controversy in consequence of the additional time allowed. I was dealing that the contention on the other side, by which it was proposed to be made out that Theiler was not an infringement, was this: In the first place the respondent maintains that Edison, on a just construction of his patent, limits his patent almost to modes of producing resistance by increasing the density of the mass and the semi-conducting material. I think that is the correct statement of it. Then they say that in the case of Hughes' microphone a different mode of action prevails. Thirdly, they say Theiler's apparatus is just Hughes' microphone, and that being so there is a different action from Edison. Now, my lord, I went through the patent of Edison yesterday for the purpose of showing that it was a mistake to say that there was any such limitation in Edison as they contended for. I pointed out that it was not essential to the validity of a patent to explain the principle on which it acts at all, and indeed it could not be taken out for a principle. If he had purported to patent a principle the patent would have been bad. What he purports to patent is certain apparatus or improvements in instruments for controlling by sounds the results of electric currents, and the reproduction of these results. Stated shortly, what he describes an improvement in an instrument to consist of is this, at least the part we are concerned with, the introduction of tension regulators, these regulators being of the semi-conducting material, which, when acted upon either by pressure or intimacy of contact, or extent of surface contact, varies resistance. He does not, as I have already pointed out, indicate or generalise any law, and on the contrary, while undoubtedly in some cases the variation is produced by pressure when he specified pressure. When he specified pressure he is describing particular modifications of his instrument, he does not purport to generalise pressure as a law. Then there is that passage on page 6, where it is very plain that he tells you how you may vary resistance irrespective of pressure by increasing the proximity or extent of surface contact. If that is so I appeal to that for the purpose of meeting the argument, that he has pinned himself to a principle, that he has generalised all his modes of action into that of compression or pressure in the mass. I think it seems quite clear that he does not so limit himself at all. Then, my lord, I pointed out that it is admitted on the other side—and I have taken the argument rather on their own evidence, leaving your lordship to consider that the body of evidence, and most valuable evidence of scientific men, has been given to the identity of the two things—neither of the respondent's witnesses did dispute, when it was put to them, that pressure did operate; that there was necessarily pressure; that pressure produced more or less compression; that it also produced by force, according to the greater or less elasticity of the materials, a greater or less extent of surface contact. And I think they both agreed in the end that although if you could get two substances which were absolute mathematical planes that would be so. Yet, as there were no materials in nature, which are almost perfectly mathematical planes, you do by pressure bring more particles or portions of what are truly rough surfaces into a greater extent of proximity of surface contact. Admittedly, then, these are common to both modes of action, the only three forces which are certainly action—there is pressure, that presure results in compression more or less, it results in an increase of surface contact more or less, it results in a greater proximity of surface contact. All these three elements the respondent's witnesses admit are common to both modes of action. Now, I ask, what is the other thing that is not common to the two? What is distinctive? Is there any fourth thing that is peculiar to either? Not one of them could tell it. They spoke of an action of what they

called a sympathetic tremor, but what does that mean? I think your lordship asked when "shaking" was introduced as a term in science. What, after all, does shaking mean in this case. When the tympanum comes back it gives a push against the two pencils, but the pencil is so weighted that it is only gently pushed; it comes back slightly. If that is shaking, then shaking takes place in ours as well. But the thing to be looked at is what are the modes of action that take place? They were not able to say, and both surmised that there was some general law which had not been got at. But if it is a general law, a *quantum quid*, it may be common to both. I put it to Mr. Blyth, yesterday, if shaking happens in the case of Theiler's, and he admitted it would do it to Edison's, that if the waves falling upon that box produced action so as to cause tremor of the apparatus inside, why should it not be the same in Edison's box, each of these being similar. But, my lord, supposing you do have the sympathetic tremor, what is the sympathy with? The use of the word sympathy is rather transferring a term of morals to physics; but if you do apply it to physics you must define it by some known modes of action; and when they were pressed upon that they always retreated to the regions of the unknown. It will never do to differentiate these two pieces of mechanism, which only look very slightly different—being almost the same in appearance—by any generalisation of that kind.

LORD M'LAREN: It is either identical vibration or harmonic vibration—the harmonic chord; but still it is just vibration.

LORD ADVOCATE: I know of nothing else, and I think that although Mr. Cooke is of opinion that the diaphragm might be dispensed with, and is only used for imposing on the public; Mr. Blyth is not of that opinion, and that if you dispense with it you cannot get such an instrument as would produce the result aimed at. I have no objection to talk of sympathetic action through the diaphragm. There was one important passage in the question of compression, because in the only case where we speak of compression you will notice that there is this striking passage: "The tension regulator of fibre or of plumbago decreases and increases its resistance enormously under slight changes of pressure." Is that to indicate that when you have made your black-lead pencil you are to grip it and squeeze it till you nearly powder it? Does it indicate that we are to treat our compressed plumbago in such a way as to compress it more? I hold that the only meaning of the word compressed there is to distinguish it from what is described in speaking of the lamp-black when you speak of the best quality of lamp-black retained within the case to form the tension regulator. It is just compressed plumbago which will stand alone as distinguished from free lamp-black put into a tube, but when you once get that you have a most distinct indication of the other theory that it is under compression that it acts. Edison's tension regulator decreases and increases enormously under slight changes of pressure, and that is exactly what our friends' carbon pencils do. They do not define the kind of pencil, but it is difficult to see that it is anything different from the compressed plumbago. Now, then, the two witnesses for the other side were not able to suggest any quality which this gas carbon, if it is gas carbon, which they have not told your lordship, possesses which is not also possessed by plumbago and other things. They say that some of them are at opposite ends of the scale. I think one thing is pretty clear, they are not at opposite ends of the scale as to the only property that we are here concerned with, because it is common ground that for the purpose of varying the resistance to the electric current these two things are exactly similar. We think the carbon button the best; they think the pencil. I do not think any one said that our carbon button was not so good for the purpose as their carbon pencil.

LORD M'LAREN: Is it a soft substance, or, although pliable, is it a hard material?

LORD ADVOCATE: I should say it is between the two. The carbon button in No. 77 is not so hard undoubtedly as the pencils. It is a good deal softer, but what I mean to say is that it is not by any means a case of filling a tube with lamp-black. It is taking up a button which might stand alone. But, my lord, I am perfectly willing to discard that, and I am quite content to take it with respect to the lamp-black here used. We propose here to put it into a tube as a convenient way of keeping it together—retained within a case, any case you like, and the case your lordship has seen. Now, what is it to the parties to say that there may be unknown qualities of matter in respect to which the two kinds of carbon differ, when in respect to the only two properties of matter that we are here concerned with they are identical? And it is common ground between us that it is the best thing to put into a telephone to vary the resistance of the electric current. Now, I venture to submit that it would be idle, even if we had been told of this unknown quality which they are in search of, and it is like the philosopher's stone, or the other things the alchemists sought after, for it cannot be got. I shall just say a word upon the last point your lordship referred to, that is—How far there is anything in our specification either to limit us in respect of the kinds of material used, or any defect in pointing out the kinds of material used. I think, my lord, the general statements on that subject are perfectly distinct on page 5, middle of page. "The resistance may be produced in various ways. I have shown several which will hereafter be named, but I find the best to be small bunches or tufts or discs of semi-elastic fibre of semi-conducting materials." That was for the tension regulator. At 36, he says the "fibres being rubbed with plumbago," and that the conducting power varies with the density of the tuft, and then he gives several illustrations of the kind of material used, but there is no limiting of himself even to carbon. It is enough to show here that he points out carbon as the best, but he points out the common qualities which it must possess. It must be a semi-conductor as distinguished from the full conducting material, and it must possess the quality, the result of being a semi-conducting material, that it varies the resistance to the electric current. If it does that, I should say it is within our patent, but certainly carbon comes within it, for it is stated as the best. I should have pointed out to your lordship that he had originally, as your lordship will observe on page 5, a claim for what was practically a water variation. He had the tension regulator made by water or other semi-conducting fluid. Well, he disclaims that now. Your lordship will see that the reason of the prefix to the disclaiming clause is explained by that original claim—this water transmission—and so he limits himself to these other forms; but I do not understand my friend's claim is that he claimed too much, but too small, that he did not claim the whole range of carbons, because if we had done so we would have claimed his carbon too.

LORD M'LAREN: The carbon button is smooth on both sides?

LORD ADVOCATE: Mr. Edison thinks there are ten million points in that.

LORD M'LAREN: Is it not so, that the contact is over the whole surface?

LORD ADVOCATE: If it were a true plane, a true mathematical plane; but like the true cross it is not easy to be found out. You increase the number of points of contact if you press them together. I would mention that it has been thought right to make a record regarding this instrument, as it may be used yet in London. It was taken away while I was speaking yesterday, and when it was brought back, upon being examined by our witnesses, it was found that it had undergone a very serious change. At first they had the impression that it was not the same one, but upon examination it was found that the top was turned the wrong way. I do not suggest anything about it, but on examining it this morning against the light I find that there is a crack right across.

LORD M'LAREN: The best thing I could do, probably, would be to direct that it should be unscrewed and restored to its original condition.

LORD ADVOCATE: I am afraid that would hardly do, because there is now a crack. If you put it up against the light you see daylight through it, therefore it would not be a good tongue now. It is no wonder that it should have suffered a little, but I mention it rather by way of notice to my learned friend, because our witnesses have signed a minute lest it should be subject to subsequent inquiry, which I show to my learned friends.

Mr. MACKINTOSH: I made inquiries with regard to that matter, and I found that the instrument was taken away at my suggestion in order to have the battery applied to it, with the result of bringing the lid down. Nothing else was done to it. Whether the thing was unscrewed at the time when the experiments were made in Court before your lordship I do not remember. I think it was.

LORD M'LAREN: Yes, it was.

Mr. MACKINTOSH: And anything that happened to the instrument happened at that time, and certainly nothing was done to it when it was out of Court during the few minutes yesterday. Now, yesterday, statements were made of the most positive description charging us with tampering with the instrument. These charges do not now seem to be maintained.

LORD ADVOCATE: There is merely a change.

Mr. MACKINTOSH: But I think it is a great pity that such things should be introduced, which are matters with which your lordship has manifestly nothing to do.

LORD M'LAREN: I noticed that the vibrating part of the instrument would not yield to the battery, but that on being unscrewed there was sufficient electric force to hold it down. It may be fairly inferred that it is owing to some alteration in its flexibility or in consequence of the handling it has undergone.

Mr. MACKINTOSH: Of course it all depends on the strength of the battery. There is a certain resistance required which has to be overcome by the battery, but I do not think your lordship will not find in this case that the instrument cannot be held down by the battery of proportionate strength to the degree marked on the instrument—1450 ohms, being a much greater resistance than Mr. Bell described in his description, the resistance to be overcome by the five-carbon battery.

Mr. MACKINTOSH then addressed the Court. He said: I have now to address your lordship on behalf of the respondent, and I shall first consider the questions under Edison's patent, and of these questions I shall first consider the question of infringement. Of course, in dealing with the question of infringement, I assume the validity of the patent, although, as your lordship knows, we maintain that the patent is bad in respect of disconformity between the provisional and final specifications. Now, my lord, upon the question of infringement the respondent's case may be shortly stated thus: We say that Edison's patent is a patent for certain described forms of a certain instrument, and that we do not use an instrument either the same, or substantially the same, as any of Edison's instruments. We say next that even if it be permitted to the complainer to analyse the various features of his patented instrument, and to confine his claim to certain of these features which he chooses to regard as essential, even in that view the respondent's instrument does not include any of the essential features of the Edison instruments. In particular, that the respondent employs for his electric tension regulators a different material, that his electric tension regulators act upon a different principle—or, in other words, has a different mode of action—and that, in addition, the arrangements and mechanism employed for the purpose in view are substantially different from the arrangements and mechanism employed by the complainer—in particular the complainer employing a diaphragm or tympan making that an essential part of his claim, and the respondent not employing, and not requiring to employ, a diaphragm or tympan, or anything equivalent to such diaphragm or tympan. Now, my lord, the first inquiry necessarily is, What is the true construction of Edison's patent? and in particular, What is the true construction of Edison's second claim? In considering that matter, it is, I think, important that your lordship should have in view not merely the terms of the second claim itself, which has been more than once mentioned already, but also the fact that Edison had previously made a great number of claims now disclaimed—namely, thirty in number—and those claims

disclaimed certain matters, the disclaimer of which is important in aiding the construction which remains. Edison does not, and it is not suggested that he does, claim to have been the discoverer of transmitting and reproducing sounds by increasing and decreasing the resistance in the circuit. He expressly disclaims that in his final disclaimer. Neither does he claim all forms of electric tension regulator—or, in other words, all modes of varying the resistance within the circuit. His claim is "the combination of a diaphragm or tympan with electric tension regulators, substantially as hereinbefore described for varying the resistance in a closed circuit substantially as set forth;" and putting aside meantime the element of the diaphragm or tympan, that claim, your lordship will observe, falls to be read in connection with two of his previous claims which are found on page 11, and which have now been disclaimed. These are the second claim and the fifth. The fifth claim claimed, "In a telegraph operated by sound, the transmission and reproduction of the human voice by increasing and decreasing the resistance to the circuit substantially as set forth"—that is to say, he claimed at that time the principle of transmitting and reproducing sound by varying the resistance. But the second claim was this: "In an instrument for transmitting electric impulses by sound the combination of a diaphragm or tympan and the electric tension regulator." In other words, the second claim claimed the combination of a diaphragm or tympan to an electric tension regulator for varying the resistance and a close circuit substantially as set forth. Therefore the claim as now made varies from the claim originally made in this respect that whereas formerly the complainer appears to have attained all electric tension regulators when combined with a tympan or diaphragm he now only claims the particular electric tension regulators which are to be found described in his specification. That being so it is quite plain that in order to bring the respondent's instrument within the complainer's claim, he must show that it is a mere modification of one or other of the electric tension regulators which he describes, and my first proposition is that taking Edison's instruments, his electric tension regulators as a whole, and taking the respondent's electric tension regulator as a whole, there is no indentity between them, no substantial indentity, and the one is in no proper or legitimate sense a mere modification of the other. Now, in order to establish that, my lord, I must first ask your lordship's attention to a matter which my friend has very naturally ignored, but which upon a question of infringement, and in particular upon a question where a certain instrument is really a mere colourable imitation of another, is always a matter of importance—I mean the history of the alleged infringement. My lord, this is not the case of a successful invention, of an invention which has attained a high degree of commercial success, sought to be pirated by somebody using the successful invention, and merely colourably varying certain of its devices or certain of its arrangements. That is the ordinary case to deal with. An invention is successful, and the infringer, making no improvement, but desirous of getting a benefit from it, sets himself down to obtain all the benefits by copying as nearly as he can the various arrangements by which the benefits are secured. That is the general kind of case, and you can easily trace the hand in the colourable improvements he makes. But that is not the case here. There are certain facts proved beyond all controversy in regard to the history of this invention. The first is that Edison's patent was, up to the May 1st, 1878, and subsequently, an absolute failure. There was not a single instance adduced of a commercial use of any of the electric tension regulators patented by Edison for any considerable time. The only commercial use which appears to have, either in this country or in America, been made of any of Edison's electric tension regulators prior to 1878 was the instance deposed to by Mr. Johnson of the use, I think, of No. 1 instrument at the Western Union Telegraph office in America. That is the only instance, and in that instance Mr. Johnson was forced to admit that the instrument was only used for a week or two, and whether it was given up because it did not work or was superseded by something which worked better he was unable to say. One thing only he was certain of—it had been in use only for a week or two. Therefore, my lord, there being absolutely no commercial use of any of these instruments up to 1878, not one of them, so far as it appears, being made for use up to that time, I think I am justified in saying that up till May, 1878, Edison's electric tension regulators were an absolute failure. Then, my lord, the next fact is this. In May, 1878, an eminent electrician—one of the most eminent electricians in this country—introduces what he regards as a new instrument depending upon, in his view, a new principle, remarkable by contrast to all of Edison's instruments by its extraordinary simplicity, and from the date when that instrument is introduced by Mr. Hughes in his address to the Royal Society, in May, 1878, the respondent and other manufacturers of this kind of instrument throughout the country immediately adopt the instrument which is thus introduced to the public—adopt it under various modifications confessedly, all of them immaterial modifications. They adopted it in the form of the Theiler transmitter, the Gower transmitter, and the Crossley transmitter; and the result is that in place of the telephone being really a kind of philosophic toy, in the course of a couple of years from May, 1878, transmitters and receivers, constituting between them telephonic instruments, came to be used in hundreds—I might almost say in thousands—over the length and breath of the country. In short, if this is an infringement, it is the infringement alone that has operated to make the Edison invention a commercial success. A vast difference has somehow been produced by the introduction of Professor Hughes' instrument, and I think I am entitled to put it, and as a fact, with which your lordship starts, that where so vast a difference in results is confessedly produced—if that be so, the last points to something more than a mere colourable imitation of something that was known before, and was described in the patent. It points to some material difference—a difference ranking almost, I might say, to a difference in principle. That being the presumption with which we start, the next thing I ask your lordship to notice is this. I do not suppose that anybody can pretend, taking any one of the instruments which are shown in the drawings annexed to Edison's specification, and comparing any one of these instruments shown in these drawings with the Theiler transmitter, as shown in the instrument now produced, the two instruments are the least alike to the eye. Nothing could well be more different at first sight than, for example, the Edison transmitter, No. 1, and the Theiler transmitter, as it appears on the table. The Theiler transmitter is certainly an instrument remarkable for the simplicity of its mechanical arrangements. It consists simply—putting aside the top piece, to which I shall afterwards refer—it consists merely of a small carbon pencil depending by a thread, and resting loosely on two other carbon pencils, but having a slight degree of weight, so as to render contact subject to a certain degree of regulation. That is the whole instrument. The material used is hard carbon. The electric tension regulator is composed of the carbon, and any action which takes place by the action of the instrument is action of carbon upon carbon. There is one or two more. I think in the instrument in question there are two loose joints between parts of the carbon, the carbon again being part of the current. These loose joints are subjected to a certain action. We shall consider afterwards what precisely that action is; but the one portion of the carbon being brought upon a certain principle into contact, or rather having its contact with another portion of the carbon varied, certain results are produced. My lord, will any one say that this is a mere colourable variation of the instrument shown in figure 1 of Edison's? One finds it impossible to point out differences where really everything is different; but certainly one or two differences suggest themselves at the very outset. For example, in place of the hard gas carbon, in figure 1 you have a fibrous material, that is to say, silk or some similar substance mixed with lamp-black powder or some other matter. Then in place of some fibrous material being brought into contact, where the current passes, with another similar substance it is brought into contact with a similar substance, but with a different substance, namely, platinum. Instead of carbon against carbon, you have carbon against platinum. Then in place of a contact as loose as is consistent without preventing absolute breach of continuity, you have in the complainers' No. 1 a tightening up of the electric tension regulator by means of screws, and the tightening up to such a maximum of tightness as is consistent with the instrument working smoothly, and avoiding the sudden or coarse impact which would be apt to produce loud, inarticulate sounds. The electric wires are led through the instrument in a totally different manner. The substance forming the electric tension regulator is not only a different substance from the carbon, but is arranged in a totally different way. It is arranged in a layer, and the effect is produced by a simple push-and-pull pressure upon that bed or layer of elastic material, particularly a cork piece attached to a tympanum. Nothing could, one would say, be more *primâ facie* different from the action of a suspended pencil playing against other pencils than the action of a piece of cork coming down upon an elastic bed of fibre below it, in the same way as a letter-press works, the lid being forced down upon the book which is held between two plates. Then, my lord, although I have taken figure 1, the other figures, I think, illustrate my proposition even better, because while one, I think, of the complainers' witnesses took figure 1 as the instrument most like respondent's, others took figure 10, and really figure 10 is an excellent illustration for my purpose, because it shows a set of mechanical contrivances for producing the common result, which are not only totally different from Theiler's contrivances, but are totally different from the contrivances in figure 1. Observe what you have in figure 10. In the first place, in place of a battery, a single battery in the line producing electricity of one description, you have, and you require to have in figure 10, according to the description, two batteries, one on the one side, the other on the other, the one producing negative and the other producing positive electricity. That involves a multiplicity of arrangements in order to give effect to what thus becomes the principle of the instrument, the variation of the positive or negative electricity in the electric current. The principle of the instrument is an ingenious enough one, but it is a very complex one. You have first of all the two currents coming up to the tympan and there being neutralised, the tympanum being in contact with the wire or the conductor, and the contact being obtained by two pieces of compressed plumbago inserted between the wire or the metal conductor and the tympanum. While the instrument is at rest, before any sound is applied, the current from one battery comes up to the tympanum, passes into the tympanum through the plumbago button, and is neutralised within the tympanum by the current of the opposite electricity which comes up in the same way on the other side. Then, when the sound comes on, the diaphragm is pressed more against the one button than against the other, and the result of that is that the equilibrium between the positive and negative currents of electricity is destroyed, and you have according to the direction of the sound a negative current of electricity, or a positive current of electricity sent through the line. That, as I say, is a very ingenious contrivance, but surely no one will say that it is the identical arrangement or substantially identical arrangement of mechanism for securing the same result either with Theiler's arrangement or with any other of the complainers' arrangements. Now, if we were to follow this out, and take figure 16 or figure 17, I think the same thing might be pointed at. I have in one of the papers before me a list of a dozen differences in figure 10. But passing over these, and taking figure 17, the first thing you have to notice there is that there is a fibrous material used. That is specified in the letterpress accompanying it that the material is to be fibrous, and that fibrous material is shut up in the cylinder, and the cylinder has got a plate of platinum and an iron plate within it, and the diaphragm operates in some way when moved—Edison clearly explains how—by way of compressing the fibrous materials shut up in the cylinders, and then the current is effected and the result is produced. But surely the suggestion that the arrangement of the three pencils is a mere mechanical equivalent for, or rather a colourable variation of, this arrangement of diaphragm

and cylinders and plates would be carrying the doctrine of colourable variation further than anybody has attempted to carry it before. Of course it may be said that wherever you have instruments producing the same result, or at all events acting on the same principle to produce that result, the apparatus used for the one is the mechanical equivalent for the apparatus used for the other. But after all, whether the one set of appliances is an equivalent for the other is a mere question of degree. There must be even between the simplest arrangement for producing a certain result and the most complicated a resemblance in this sense, that the one is a mechanical equivalent for the other—that is to say, they produce the same effect. But that is not what people talk of when speaking of patents. A mechanical equivalent in such a case is just this, that it is a mere copy, the variations being intentional in order to avoid the charge of infringement. If a patentee wishes to stop that kind of thing, and thinks himself entitled to do so, then his resource is to claim not an instrument or a certain number of instruments, trusting to catch all infringers by proving that they are using modifications of his instruments, but to take out of his instruments the features on which he founds and claims all instruments having those features which he holds to be essential. In that case the public know what they may take and what avoid, but it will never do for a patentee to come into court claiming an instrument, a concrete instrument or a number of forms of a certain instrument, and then turn round and say, Oh, after all, the one thing in all these forms which I was really claiming was a certain mode of action, and wherever that mode of action was found there was an infringement. It is quite open for a patentee so to put his claim as to cover all appliances, but if he chooses in place of doing that to describe a dozen or half a dozen different forms of his instrument which he thinks will cover all available forms of his instrument, he cannot turn round and say that the set of mechanical devices shown in my arrangements are entirely immaterial. I never meant that this might not be varied at pleasure; I attach no virtue to that; the one thing I really claim is the mode of action which is common to these instruments, and if you take that, no matter what method you adopt, you are infringing my instruments. That will never do, and I have never heard of anything such as this being attempted, much less being successful. If I am right in reading his patent, that he has not adopted or claimed the right of adopting the principle of certain mode of action, but has gone upon the principle of taking a certain number of concrete instruments, pinning himself to these, then he must say before he can make out that my instrument is an infringement, that, taking it as a whole, mechanism, mode of action, material and everything else, it is a mere modification of some one of the particular instruments which he describes in his letterpress or shows in his drawings.

LORD M'LAREN: Do you contend that in order to constitute an infringement the imitation must be a colourable one? Is it not enough if it is substantially the same process, although it may be an improvement as regards means and mechanical arrangements upon the one shown by the patentee? I do not doubt in the least that your form is an improvement on this shown in the specification, but that does not affect the view I might take as to the result of this action. You can have a patent for an improvement on an unexpired patent, and the one who wants to use that must take a licence for both. Might there not be an infringement, although not colourable?

Mr. MACKINTOSH: I am obliged to your lordship for putting that question, because it supplies a test to my argument which is very useful. You cannot certainly have a mere colourable modification where the result is a substantial improvement. If the mechanism I employ is so different as to produce a substantially different result, then it cannot be said to be a mere colourable imitation, and my proposition on the construction of Edison's patent is this, that he has taken his risk of claiming, not a mode of action or certain features common to his various instruments, but of claiming certain concrete examples of the electric tension regulator, which examples he describes, and which he claims, and which can only, according to the construction of his specification, be infringed if you make what is a mere modification of one or more of these particular instruments. The question your lordship has put all turns upon what the claim is, what the patent is for. I quite concede that if Mr. Edison had here claimed, as he might have done, the varying of the resistance within the closed circuit by means of pressure applied either throughout the mass or at the surface, he would then have had a patent for what might loosely be described as a principle, and all he would have required to do in that case would have been to show some one useful mode of applying that principle. Having shown one useful mode of applying it—or, in other words, one useful concrete instrument—he would have been entitled to take any instrument, however the mechanism might be varied, which acted upon his principle, and if a subsequent inventor discovered a much improved mechanism to that shown as an example by the patentee, then he would be entitled to a patent for the improvement, but all the same would have to take a licence from the original patentee. But that can only apply where the patentee takes out his patent for what I have called the principle rather than for the concrete apparatus. The instrument must be taken as a whole, material, mechanism, mode of action, all must be looked at together before you can say that any particular instrument is an infringement of the patent. But, my lord, I am not at all resting my case upon that view of Edison's patent. I put that forward as my first proposition, that there is no infringement, because I do not take any one of his electric tension regulators or any mere modification of them. But I shall pass now to Edison's own theory of his patent, and shall assume, for the sake of argument, that he claims, or is entitled to claim, all instruments which use the same or a similar material which act upon the same principle, that is, according to the same mode of action, and which are combined with a typanum or diaphragm. I think, my lord, that is the most favourable view for the complainers, that I should take it that it is a patent for certain features common to a variety of patents. That raises this question: What are the features which Edison claims as essential? I think he does not describe any one thing about the electric tension regulator as more essential than another. His mechanism is as essential to the device as the material or the mode in which the tympanum acts upon the material.

LORD M'LAREN: He does not claim an improvement in the transmission of sound by any mode of variation in the electric current?

Mr. MACKINTOSH: I have no doubt he had reasons for not doing it. He did it at first, but does not now. He does not claim all electric tension regulators, or all electric tension regulators composed of the materials specified. The kind of suggestion he makes is this, that he claims all electric tension regulators which are of carbon or of any similar material.

LORD M'LAREN: The reason for not claiming any mode of varying the resistance was that it might be inferred by some that even under the simple instrument invented by Bell the effect was produced by varying the resistance in another way. My impression was that the subsequent inventions are modes of producing a much greater variation than was possible under the simple transmitter.

Mr. MACKINTOSH: I rather think that Bell's principle is substantially worked in this way, that the tones of sounds produced the current of electricity directly; the sonorous vibrations acted upon an electro-magnet which produced the current of electricity, which, in its reception, was according to its strength and weakness. In that way the variations in strength and weakness of the current, which is produced in Edison's and Theiler's by varying the conductivity in the line, was produced in the generation of the current by the direct action of the human voice. I really do not profess to know why it is that Edison disclaimed the discovery of varying the electric currents by varying the resistance in the circuit, or, in other words, varying the conductivity. He must have known of something that would have anticipated him if he had not done that, and accordingly he did not do it, and even where the effect is produced by the operation of the tympan or diaphragm he does not claim the variation. He carefully confines himself to the variation by the electric tension described, and it is important to notice the contrast between the second claim as originally made and in the disclaimer. He, in the original claim, claimed a combination of the diaphragm or tympanum with any electric tension regulator. He found that was too general, and he claims the combination of the diaphragm or tympan with certain described tension regulators. And that is really at the very root of infringement and it is a matter on which your lordship must first make up your mind. Is it a patent for a principle, or is it a patent for the principle exemplified merely by certain concrete forms, or is it not a patent for certain kinds of electric tension regulators, and that he was safe from piracy because no one could produce the effect without some one or other of his instruments.

LORD M'LAREN: I should have thought he in the original specification proceeded on the principle of enumerating all possible modes; that he may have thought it dangerous and difficult, and may have preferred afterwards to limit himself to two or three of the best forms, putting in the word "substantially," and trying to cover others that might appear to be mere modifications.

Mr. MACKINTOSH: Yes, that is a very common form. Nothing is more common than for a man to present a complex mechanism for a desired result and to say, "I claim that, or any modification of it." It may even consist merely of a drawing, and the man says: That is my specification, to be used for a certain purpose. But if he takes that form he cannot pick and choose among the features or the elements of the apparatus he selects. He must stand or fall by the difficulty, or the impossibility of anybody attaining the successful result without copying his apparatus as a whole, and so copying that the copy will be recognised as a mere colourable variation. But for the sake of argument I am quite willing to proceed to consider whether there is here an infringement of what Edison maintains, or what may be held upon his specification to be the main features or the essential features of his electric tension regulators. Of course I start with this that where a party is desiring to pick out certain features of an apparatus and to stamp them as the essential features, he must make it very plain upon the specification what these essential features are. It won't do for him just to throw an instrument at the public and say, "Now, I claim that and the essential features of it whatever they may be." The public are entitled to know if the invention is something else than the instrument as a whole, what it is that they may, and what it is they may not take; and therefore it is an elementary principle of patent law that where an apparatus is merely exhibited as an illustration, and the real claim is for certain essential features of that apparatus, these essential features should be carefully described in the specification. The patentee, if he describes wrongly, or omits to describe them, fails. No doubt nobody can use his apparatus as a whole whether the principle is rightly or wrongly described. A man who puts before the public a valuable instrument, whether he himself knows the true principle of its operation, can claim a patent for it; but where he is departing from the instrument and taking his stand upon the principle, that principle must be specified, and correctly specified, so that the public may know, as it is the object of all specifications to make known, what it is they may take and what they may not take. In that point of view let us see in the first place what the principle of Edison's electro-tension regulators is, or rather what according to his own description it is. Now, my proposition there, my lord, is that taking Edison's patent and reading it as a whole, the principle running through all his descriptions is compression, and compression communicated as far as possible to the mass, there being as little looseness of contact at the points of junction as is sufficient to prevent sudden impacts. That I maintain to be the principle, if there is a principle, running through the whole of Edison's descriptions. That it is the principle running through all of the drawings, all of the instruments shown in the drawings, I do not think your lordship will have the slightest doubt. It is manifest on the face of it as regards those examples of the instrument where you have the elastic fibre, with or without plumbago powder, as the regulator. There you necessarily have compression applied to an elastic

surface, and communicated to and operating through the whole mass, so as to increase its density, and thereby to vary its conductivity. But even with regard to that sheet anchor of Sir Frederick Bramwell, figure 10, I take it that a very slight examination of the figure, and the letterpress description of it, shows that the principle even there is substantially the same, because the only difference between the operation of the instrument in figure 10 and in figure 1 is this—that in figure 1 the pressure is vertical, and in figure 10 it is lateral. And, with regard to the material used, while in figure 1 you have the fibrous material, in figure 10 you have the compressed plumbago mixed with gum rubber; and, my lord, looking at the complainer's own representation of figure 10, it must be quite manifest to your lordship that it is vain to talk of pressure merely at the points of contact, but on the contrary there is just as great a pressure throughout the mass in this case as you have in figure 1, allowing only for the different degree of elasticity in the compressed carbon as compared with the fibrous matter used in figure 1. You have here, no doubt, pressure applied at the surface, and I do not say, moreover, that you do not have the pressure applied at what I may call the point of contact, or the joint where the electric tension regulator is attached or joins on to the rest of the circuit. Probably you have, but my point is that you have there an arrangement of screws and other mechanical contrivances whereby a direct pressure of the whole mass of plumbago was applied, and moreover is creating a pressure such as was requisite to communicate a change of resistance to the mass. It is not mere delicate pressure at a point. It is not a contact where looseness of contact is aimed at. It is a contact which results in a pressure throughout the mass, and which is made as light a contact as is consistent with the prevention of impact or blows or sudden strokes which would disturb the instrument.

(*To be continued in our next.*)

REVIEW.

Report of the Lightning Rod Conference. London: E. & F. N. SPON, 16, Charing Cross.

(*Continued from page* 74.)

WITH reference to "Testing Conductors," the report says "it would be advantageous if some competent person were officially appointed, either by the government or by some recognised authority, to perform this duty." The members of the conference have undoubtedly done right in making this recommendation, but we think that considering the importance of the case they should have expressed themselves more strongly than by using the word "advantageous." The necessity for some supervision, not only for the purpose of testing well-constructed conductors, but also for the purpose of seeing whether their construction is good or not, can be shown by numerous cases. On page 209 we find a letter written from the Irish Lights Office, Dublin (a Government office), in which a full account is given of damage done to the Berehaven lighthouse during the early part of the year 1877. Towards the termination of the letter we find the following remarks:—"The conductor . . . . then continues down the face of the tower, closely pressed to it by the iron holdfasts and copper bands, which secure it until it reaches the rock at the base of the tower, *where it terminates in a small hole three inches by three inches, jumped out of the rock about six inches under the surface.*" (The italics are our own.) No remarks are made in the report upon this efficacious way of terminating the conductor, and it seems probable that no notice has been taken of the same.

As regards conductors which have become defective since construction, we read on page 243 an abstract of a paper written by Captain Bucknill, in which it is stated "he has found in practice many bad joints, especially in copper conductors. At Tipner one gave 10,000 ohms, and one in the Isle of Wight 700 ohms. Each joint was apparently quite sound." A strong representation to government might do something, but this, we believe, has never yet been attempted. In a careful analysis, by Mr. Preece, of the letters received from the manufacturers (which analysis we observe was made as early as August, 1879) it is pointed out that when a number of conductors are joined to a main conductor the latter should be of larger dimensions than each of the former; no remarks are made with reference to this point in the report. Appendix D contains the report of the representatives of the Royal Institute of British Architects to the Lightning Rod Conference. In this report it is stated that 700 circulars were sent out to the members and associates of the society, requesting information concerning buildings that had been struck by lightning; the result was that 36 replies were received, showing how surprisingly little interest is taken in the subject.

In a paper read by Mr. Symons before the British Association in 1860, which is reproduced on page 46 of the report, we come across the following: "I believe that the reason that conductors are so comparatively seldom used may be expressed by one word—expense;" a remark made by Professor W. Thomson, at the Aberdeen meeting, was a strong illustration of this point: "If I urge our manufacturers to put up lightning conductors they say, 'It is cheaper to insure than to put up conductors.'" These remarks speak volumes; we believe that the insurance premium is in no way affected by the presence or absence of a lightning rod on a building, no matter how exposed the latter may be to damage. It is somewhat difficult to understand why this is the case, for it cannot be said that accidents to buildings by lightning are of rare occurrence.

On page 49 we read of the curious case of two sea-gulls, while flying, being killed by lightning.

Too much importance cannot, we think, be drawn to the necessity of protecting collieries by lightning conductors. More than one case has occurred in which accidents could be traced to lightning, yet the only attention which is paid to this subject in the report is in a reprint of an extract from the *Newcastle Daily Journal*, where a case of lightning striking the colliery is fully described.

On page 70 we find an excellent report by the inspector-general of fortifications as to the application of lightning conductors for the protection of powder magazines, &c. A good deal of this report might certainly have been incorporated with advantage in the report of the conference. Thus we notice the following paragraphs:—

29. In buildings of uniform height, provide a solid rod 5 feet above it at each end, and at each 45 feet in length. If the conductor be of iron the top should be gilt.

30. Buildings not over 20 feet long to have one vertical conductor at end, and a horizontal conductor along ridge.

31. If 20 to 40 feet long to have one vertical conductor in centre, and one along ridge, as last.

32. If 40 feet long to have two vertical conductors; if 100 feet long three conductors; in both cases with conductors along ridge.

34. Each prominent part should have a conductor—and so on.

Here we have very definite instructions, which can easily be followed out; this is more than can be said of those in the report which occupies the first portion of the book we have before us; a great deal too many of the directions are of a mere general character and lack definiteness.

In conclusion, we must say that although we think that every effort has been made by the members of the conference to obtain such information as would enable them to present a fair and valuable report, yet we think at the same time that they have failed to produce a work which is likely to command much attention, or which will be considered as authoritative or useful.

NOTES.

ELECTRICAL HUMBUGS.—The wonders which can be actually performed by electrical agencies are so marvellous that it is no wonder that the public in general have unlimited faith in the powers of this force. In the presence of the telegraph, the telephone, the electric light and a dozen other successful applications, he would be a bold man who would pronounce against the possibility of any achievement. This fact does not, however, prevent us from deciding against certain obvious humbugs and swindles which are to-day too common. Electricity has its laws as well as gravitation, and the man who proposes a scheme to which they are obviously opposed is either a fool or a knave. Some of the swindles which are now before the public are exceedingly barefaced, and yet they are wonderfully successful in drawing the money out of the pockets of the people, and the most emphatic testimonials from "respectable" clergymen. One man sells a hair-brush for which is claimed

all the virtues under heaven—all due to electricity. To convince the gullible portion of the public that the brush has great electrical power, those who sell it exhibit its action on a magnet, and as the brush is apparently made of non-magnetic material, the effect is supposed to be due to the electricity which is somehow stored in the brush. The fact is, however, that there is a small steel magnet concealed in the substance of the back of the brush, and it is to this that the action is due.

Others present to the public what they call magnetic or electrical garments under various names. What adjectives are too strong to characterise the fraudulent claims made for these articles? That electricity is a most valuable remedial agent, when properly directed and judiciously applied, there can be no doubt. But these men know nothing either of electricity or medicine; all they want is money, and they make up for the lack of knowledge by the most unblushing assurance and the most lying claims. The articles which they sell violate the most elementary principles of natural science, and our young readers are cautioned to beware of them. The most astonishing thing is that their advertisements are admitted into professedly scientific, and even into some medical papers, thus lending to them a *quasi* indorsement which no respectable paper should give even in its advertising columns.—*Young Scientist.*

ELECTRIC LIGHT ON THE SEA COAST.—At a recent scientific meeting a paper was read by a Dublin scientist in direct opposition to the employment of the electric light in lieu of the ordinary gas or oil as used in lighthouses. His objections were mainly these: It is difficult to ascertain the proximate distance; the light does not show itself as strongly as claimed in fogs, and therefore the principal advantage which it was claimed mariners would derive from its use have not been proved to belong to the light. This paragraph has been largely copied into the European Continental press, and just at the present moment, when there is a movement on the part of both public-spirited and scientific men to have the light more largely employed for maritime purposes, it is of great importance to ascertain whether such views are justified in themselves or shared by European electricians and nautical men. And here we may be allowed to say a few words about lighthouses. Their total number in 1830 was only 515. In 1870 they had increased to 1,785 for the European coasts; to 674 for the American; 182 for the Asiatic; 93 for the African, and 100 for the Oceanic coast; or a total of 2,814.

The experiment of electric lighting for those warning towers was made in France as early as 1863, and was so satisfactory that two other lighthouses were provided with the system in 1865. Not only this; in January, 1880, the minister of public works in France presented a memoir in favour of the adoption of the electric light along the entire coast. The French public engineers (*des ponts et chaussées*) by their general council decided, on March 3rd, 1881, that 46 lighthouses should be included in the plan. Of this number 38 are lighthouses of the first class. The light in the Isle of Planier, eight miles from Marseilles, will be flashing with three white and one red flash. It will be visible during an average state of the atmosphere for a distance of 48 miles, but its geographical effect will be only 21 miles. Special efforts are being made, however, to increase the luminous effect in preference to distance. A great advantage has been made in this respect by the use of optical apparatus of special construction. They are provided in their upper part with a series of lenticular rings which have the effect of throwing up a pencil of vertical rays to a great elevation above the apparatus. This pencil illumines the clouds or vapours that fill the atmosphere, and is equally visible itself in clear weather, as the air contains enough of solid particles and vesicular vapour to produce diffusions. The reach and practical utility of the electric lighthouse is thus greatly increased. The first experiment with it was made in the Sea of Azov, at the port of Berdiansk. The cost of the electric lamp will be only from one-fourth to one-fifth that of oil. But, there is something more important still in favour of electric coast signals. The present oil system is practically worthless during 180 days of the year along the Atlantic European coasts, and even for 120 days in the "sunny" Mediterranean. The electric will only fail on very foggy nights, or one in 12 and one in 18 on the coasts of the waters just mentioned. Their power will reach from 22 to 27 sea miles further than that of any existing lighthouse illumination.

These practical experiments dispose of many theoretical objections which have previously been urged. In electric affairs, as in everything else, there is no absolute perfection; but, when there is a palpable and decided advantage to use the miraculous agency it ought to be recognised at once, and *acted upon*. The ferry boats of New York and Brooklyn cross a narrow width of water of some 1,000 yards in the midst of fog—there is scarcely room for doubt that the use of electricity would do away with what is at present a cause of delay and great danger.—*The American "Electrician."*

A NEW INSULATING MATERIAL—GELATINISED FIBRE.—This remarkable material is composed of a specially prepared vegetable fibre, which is subjected to chemical treatment under great pressure, producing a dense, hard substance, very similar to ivory or horn, and capable of being worked in a lathe, drilled, sawed, riveted, stamped, &c., and is susceptible of a very high polish. It does not deteriorate by age, but rather improves by seasoning; is exceedingly tough and strong, and will sustain an enormous pressure without change of shape or injury. It has a wide range of mechanical uses, as a substitute for hard rubber, and is sold at one half the price of the latter. It is especially adapted to electrical uses, for all positions where not exposed to the weather, being one of the very best non-conductors, and is largely used by the principal electricians and manufacturers of electrical instruments and machines throughout the United States, all of whom give it their unqualified approval. It is said to have stood some very remarkable tests by expert electricians, giving better results than any similar material hitherto offered on the market. It is well worth investigation by all parties interested in such matters, as a really good, cheap, and durable insulating material.—*The American "Electrician."*

ELECTRICAL SHEEP SHEARS.—Mr. Edison has referred to us a communication from New Zealand in which the writer sets forth at length the pressing need of some means

of shearing sheep evenly, rapidly, and without risk of hurting the animal. Sheep raising, it will be remembered, is most largely carried on in sparsely inhabited districts where skilful shearers are hard to get. The writer appeals to Mr. Edison, thinking that an electrical apparatus might be made to answer, the cutting to be done by means of a wire highly heated by an electric current. The length of the heated wire or cutter would have to be about three inches. The use of an incandescent wire of platinum for cutting has been entirely successful in surgery, in removing tumours and other diseased or morbid growths, and there is a possibility that it might answer for cutting wool. Whether the heated wire would injure the wool, or whether the accumulation of ash would speedily make the cutter inoperative, are questions which trial alone can decide. Some years ago patents were taken out for a method of felling timber by the use of wire electrically heated, but when the method was put to practical test it failed, as the ash of the burnt wood soon surrounded the wire with a fire-proof shield. Whether a similar difficulty would arise from the coating of the wire with wool ash and charred wool on applying the method to wool cutting, and whether this or other possible difficulties can be easily overcome in an electrical shearer, can be determined only by trial.—*Scientific American.*

MAGNETIC DRESSING.—At the Friedrichsegen mine at Oberlahnstein, Germany, blende middlings, containing spathic iron ore, are calcined in a simple reverberatory, with an inclined hearth. The spathic iron ore is thus converted into sesquioxide of iron, which is then extracted by a magnet, the undecomposed blende remaining behind.

THE SUBMARINE TELEGRAPH COMPANY.—The *Lady Carmichael*, the repairing steamer of the Submarine Telegraph Company, arrived off the Silvertown Cable Works, on Tuesday, the 7th inst., to take in some five miles of multiple cable before carrying out some repairs to one of the Channel cables. Mr. Bordeaux and his assistant, Mr. Marsh, are to be congratulated on the very short time occupied in repairing the North Zanvoort cable. It appears that they experienced excellent cable weather during the past week, and Mr. Bordeaux's great local knowledge enabled him to profit by the occasion and re-establish communication in three days after the *Lady Carmichael* started from Lowestoft. From the general rapidity of the repairs undertaken in connection with this vessel, she would appear admirably adapted to the work she has to do. Her fault, if it may be considered one, is that she is a trifle too small on the score of accommodation for the men on board. Be that as it may, the management of the Submarine Company deserves great credit for the efficiency of their arrangements for carrying out to a satisfactory issue any cable work which may fall to their share.

ON CERTAIN PECULIAR FORMS OF SPARKS IN THE AIR.—By A. Righi.—It is difficult, when discharging a condenser, to divide the spark into two equal branches. This can be effected if two balls, *a* and *b*, connected with the internal coating, are placed at equal distances from a metallic plate, *d*, and between the inner coating and the balls there are introduced two tubes of distilled water of such a length that the sparks appear yellow. If the distance of the two balls from each other is changed without varying the distance from the metal plate, on sufficient approximation a spark passes from one ball to the other and at the same time a spark from *a* to *d*. The spark from *b* to *a* sometimes strikes the spark from *a* to *d* in the middle. If there is formed a spark, *a d*, there is formed in consequence of the heat a track of diminished resistance which the spark from *b*, being delayed by the stratum of water, selects. If two balls, *a*, *b*, are placed at equal distance from a third, *d*, the sparks passing from the former to the last form a Y if a layer of water is interposed. If the three balls lie in a straight line the sparks appear between them simultaneously.—*Mem. di Bologna.*

APPARATUS FOR DETERMINING THE PROPORTION v OF ELECTRO-MAGNETIC AND ELECTROSTATIC UNITIES.—By M. Stoletar.—A condenser of the surface S, and the distance of plates δ n, is charged one hundred times in a second by a battery, and discharged as often in the same time by a galvanometer. If i is the deviation, A the constant of the galvanometer, F the electromotive power of the battery, C_m the capacity of the condenser in electro-magnetic measure, then

$$nF\,C_m = Ai$$

F and A can be eliminated by conducting a branch of the current through the galvanometer, and thus C_m can be determined. The capacity of the condenser in electrostatic measurement is $C = S/4\,\pi\,\delta$ and $C_m = C/v^2$. If, therefore, S, δ, and C_m have been measured, v is determined.—*Soc. Franç. de Physique.*

ON THE ELECTRIC CONDUCTIVITY OF GASES.—By Zomakic.—A condenser is discharged into a Reiss air-thermometer, whilst a discharging tube is introduced into the circuit or not. The total quantity of heat produced is constant. It is said to increase in the tube with the resistance of the gas, becoming successively feebler in carbonic acid, air, and hydrogen. The resistance would thus be proportional to the spark length ; it decreases with heat, and is little affected by pressure if approaching that of the atmosphere.—*Journal de Physique.*

ON THE THEORY OF THE ELECTROPHORUS AND ITS ANALOGY WITH CONDENSERS.—By E. Billari.—The dielectric plate of resin or ebonite to be examined, was rubbed with cat-skin on its anterior surface, and the charge of the posterior surface was examined with the test-disc. The anterior surface was always negative, and the posterior positive, the latter predominating. If a Franklin plate with movable coatings is charged, the charges of the glass surfaces are homologous with those of the coatings. A table of several plates of glass has on all its anterior surfaces which are turned to the positive coating a positive charge, but a negative one on all its posterior surfaces. The same thing takes place as is known with two plates separated by a small interval. On charging and discharging, a transfer of electricity takes place between them. If the coatings of a Franklin plate are connected with a galvanometer, and removed from, and approximated to, the plate, strong deviations of the needle are obtained. — *Wiedemann's Beiblätter.*

DISPLACEMENTS AND DISTORTIONS OF SPARKS IN THE AIR BY ELECTROSTATIC ACTION.—By A. Righi.—It is

known that with increasing density of the electricity at the electrodes the discharge takes place with smaller potential function. The spark is longer between small balls; if the density on one of the balls is diminished by conduction to the earth the discharge ensues later. In general the ball upon which the electric force is greatest produces before the discharge a more powerful current of repelled molecules of air. A body brought into its neighbourhood deflects this current more energetically than that produced at the other electrode, whereby also the spark is deflected which is formed where the electrified air-currents receive it, and form for it a track of minimum resistance. If two balls, *c* and *d*, fixed upon vertical conaxial metal rods, are placed opposite to each other, connected with the conductors of a Holtz machine and two metal plates, *a* and *b* respectively, positive and negative are approached to them at an equal distance on both sides, the stream of sparks turns towards the positive plate if the positive ball, *c*, is connected with the earth inversely. If the positive ball, *c*, is larger than the negative, *d*, and if both are isolated in this case also, the stream of sparks turns to the positive plate, *a*.—*Wiedemann's Beiblätter*.

CRYSTAL PALACE EXHIBITION.—Since writing our article concerning the Crystal Palace Exhibition of Electric Lighting we have been informed that the deputation representing the various firms who have been compelled to call the attention of the Palace directors to their grievances were on Tuesday afternoon last granted the interview they sought. Amongst the telephone exhibitors present we may mention the names of Messrs. F. Pope Cox, J. Orme & Co., and Harrison, Cox-Walker & Co. The complaints set forth were as follows:—

First. That undue privileges had been granted to the Edison-Gower-Bell Telephone Company, inasmuch as that Company only was allowed to have telephonic communication with the theatre, concert-room, opera house, and organ. Mr. F. Pope Cox pointed out that it was unjust to the other exhibitors of telephones that a monopoly should be maintained for any one Company, and that all should be placed on an equal footing, otherwise the complainers could not show all the benefits to be derived from the use of the telephone; and if they were debarred from enjoying equal privileges their disadvantages would be great. The Chairman of the Crystal Palace, in answer, said that arrangements had been made with the Edison-Gower-Bell Company, financially and otherwise, of a different nature to that of other exhibitors, and that as a matter of fact the above Company was not in any way part of, or connected with, the International Electrical Exhibition. To this, Mr. Pope Cox replied that the first edition of the official catalogue of the exhibits contained the name of the Company as amongst those exhibiting, the musical entertainment being specially mentioned, and also that the space allotted them was marked on the plans; and he moreover drew attention to the fact that this had been withdrawn from the second edition of the catalogue, and that further space had been allotted to the Company in the nave. This, however, was also explained to the deputation as not appertaining to the Exhibition.

They were also informed that they had no claim on the music of the Palace, and that if they had telephonic connection with the concerts the Palace Company would probably be deprived of a certain percentage of receipts for the reserved seats in the concert room. The deputation asked to be allowed to place telephone transmitters in various other musical parts of the building, but this was not granted. The manager suggested that the complainers should employ (at certain hours to be agreed upon) a violinist, or vocalist, to play, or sing, at some one of their stands, in connection with another, the arrangement being made reciprocal. Mr. J. Orme then stated that their second complaint referred to the malicious damage to telephones and apparatus connected therewith, which some of their number had sustained. At Mr. Pope Cox's station by the fountain the connecting cord had been cut and the receiver broken, and at the south-east entrance the transmitter had been fractured and pulled away from its metal brackets. Messrs. Gent & Co.'s instruments had been tampered with; F. J. Smith had had his batteries broken up; and those of Mr. Cox-Walker had all been utterly spoiled by some chemical poured into them. The Chairman expressed great regret at this, but pointed out that they could not accept any responsibility in the matter. He would only be too glad if the complainers could assist the Palace Company in discovering the authors of the outrages, so that they might prosecute the offenders. There were now, he stated, several detectives in plain clothes, who would do all in their power to prevent any further interference with the exhibits. The remaining complaints were chiefly confined to the spaces occupied by the complainers, the galleries at night not being illuminated even by gas. They also drew attention to the necessity of some effectual means being adopted of intimating to visitors that a portion of the exhibition was held in these galleries. The Chairman deplored that the lighting by electricity was not in a more advanced state, but stated that it was in no way the Company's fault, and he anticipated that at a very early date the electric lighting of the Palace would be complete. As to advertising the fact that part of the exhibition was in the galleries, he said that placards were being prepared for this purpose. He also suggested that the complainers should arrange to give half-hour lectures on their exhibits once or twice a week; but as these lectures would necessarily have to be given in front of their respective stalls, the deputation did not express any opinion on this subject. After other observations of an unimportant character, the Chairman was thanked by the members of the deputation for the attention he had given to their complaints, and they then withdrew.

LECTURES ON ELECTRIC CURRENTS AND ELECTRIC LIGHTING.—We are glad to see that Professor Sylvanus Thompson is to deliver a course of four lectures at the Crystal Palace on "Electric Currents, Arc Lights, and Incandescent Lamps." These will take place on the Wednesday evenings, February 22, March 1, 8, and 15. Other lectures on electricity will, it is stated, be duly announced. For prospectus, application should be made to the Manager of the Crystal Palace.

CORRESPONDENCE.

THE TELEPHONE CASE.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—I have read with great interest and much care your report of the Telephone Case at Edinburgh, and I confess that during my perusal of your lengthy report, I many times almost involuntarily exclaimed, *omnis homo mendax;*

and these three familiar Latin words I translate into "all men are liable to err," lest some of your readers should render them in the usual harsh sounding English translation.

As many of your readers already have the case in full before them (through the medium of the pamphlet you have issued) it is unnecessary to recapitulate the statements of facts set forth respectively by the complainants and by the respondent. It is necessary, however, that I should state that the respondent is accused of having infringed letters-patent, No. 2909, dated July 30th, 1877, granted to Thomas A. Edison, and the several disclaimers filed 10th February, 1880, and 15th June, 1881, and also for infringement of letters-patent, No. 4765, dated 9th December, 1876, granted to William Morgan-Brown, being a communication from Alexander Graham Bell, and the disclaimer filed 13th February, 1878.

The defence set forth by the respondent was that the two several inventions were publicly known and used in the United Kingdom prior to the dates of the respective letters-patent.

The first witness examined on the part of the complainants was Sir Frederick Joseph Bramwell, F.R.S. This witness, after having described three modes of operation of Bell's invention, stated, "in all these cases there is a closed circuit which is used to produce undulatory electricity"; "*so far as I know* it was novel at the date of Morgan-Brown's patent." This saving clause—"*so far as I know*"—is very fortunately used by the witness. *See* Bell's United States patent, which was on file in the British Patent Office, on 3rd July, 1876. And further, that eminent scientist Count du Moncel, in page 37 of his book "Le Téléphone," said in the most positive manner that Bell was not the first to use undulatory currents. In Bell's paper, read before the Society of Telegraph Engineers on the 31st October, 1877, Count du Moncel appended to the following words then used by Bell, "Mais les courants ondulatoires n'avaient pas été employés avant moi," the following note, "Ceci n'est pas exact, car M. Elisha Gray en avait déjà reconnu l'importance pour les transmissions des sons combinés."

This witness, when questioned in regard to Reiss's invention of 1863, said, "It was incapable of perfectly reproducing speech," and further that "Bell's invention was the first by which articulate speech could be managed and reproduced," and that the invention was novel "*so far as I know*." In reply to a question put by Lord M'Laren, the witness said, "Articulate sounds might occasionally be reproduced by Reiss's invention," but it is equally a fact that it could not make a fac-simile of the speech that was sent;" "a monosyllable of one tone might be sent."

The statements of this witness in his examination in chief amounts simply to this, that Bell's invention was novel at the date of the patent, December 9th, 1876, and that it was the first by which articulate speech could be reproduced, qualified with the words, "*so far as I know*." It seems to me that the witness meant a great deal by the expression "so far as I know," which he always used in connection with his opinion as to the novelty of Bell's invention.

The witness, in speaking of Reiss's invention, said, "It was incapable of perfectly reproducing articulate speech," but he did not qualify his statement by the words, "*so far as I know*"; it was a positive assertion; however, when Lord M'Laren put to him the question, "Is it a fact that articulate sounds could be produced by Reiss's invention?" his reply was, "Occasionally they might," "a monosyllable of one tone might be sent."

We have then the positive assertion of this witness that "Reiss's invention was incapable of reproducing articulate speech," and the admission that "Occasionally they might be reproduced."

It is evident that the witness had never seen or tested Reiss's instrument, and consequently was not justified in the statements he made in regard to the actual operation of the instrument; these statements are evidently his own deductions from having read a description of Reiss's instrument. I respectfully submit could this witness, or would he, state, after a perusal of Bell's specifications, that the instrument could "reproduce articulate speech?" My translation from the psalmist appropriately comes in here, and it is clear that the opinions of this witness in regard to the undulatory current, the closed circuit, and the reproduction of articulate speech, are based upon a somewhat limited knowledge of prior inventions, and I respectfully refer to Cromwell F. Varley's patent of 1870, to Elisha Gray's patent of 1874, to the book "Le Téléphone," p. 37, published by Count du Moncel, in 1878, as evidence indisputable that the closed circuit and the undulatory current were used for the purpose of reproducing sounds. I submit without fear of contradiction that the original instrument of Reiss did and does now reproduce articulate speech, which fact has been established, and can be again, by actual trials.

I now suspend for the present my remarks upon the statements of this witness about the Edison letters-patents, and shall proceed to those of Sir William Thomson, whom Lord M'Laren is pleased to declare to be "the most eminent electrician in the United Kingdom." It is more than surprising that before such an authority memory reproduces to my mind the words: "men dare rush in where angels fear to tread."

This eminent professor stated that he was one of the judges at the Philadelphia Centennial Exhibition, 1876, that Bell "showed to him an instrument capable of producing a fixed note," but "not capable of producing articulate speech." Afterwards Bell showed him something else, which he (Bell) said: "he would hardly call an invention, but which might ultimately become an invention, and then the telephone was shown to him in connection with a battery and line wires," and Bell said: "he could show us something which would speak, and on that occasion, in presence of the Emperor of Brazil (here parenthetically let me say that no doubt it was in deference to the august presence of his imperial majesty that the "telephone, after some troublesome adjustment," spoke six monosyllables—"to be, or not to be"—from a royal speech (Oh! wonderful effect of royalty). Sir William proceeds to state: "I felt so very much interest that I went too far and said the thing was done." My friend, Professor Watson, heard it faintly; it required very minute attention, but I am absolutely convinced myself that I did hear it." This was the only occasion on which Sir William heard of the receiver, and this in the presence of royalty. Mr. Bell gave to Sir William instruments, which Sir William brought to Scotland, and Sir William proceeds to say: "I tried them and worked a good deal with them; I tried various combinations of battery powers, but all with no effect." "I continued my experiments for some considerable time, making several experiments, but never got it to speak a word," and, again, Sir William said: "I dropped my experiments at Glasgow as a failure."

The instrument given by Bell to Sir William was that described in the fourth plan in Bell's specifications, and exhibited in drawing No. 19, for which Bell had obtained letters-patent in the United States, No. 174,465, dated March 7th, 1876, and filed Feb. 14th, 1876, the title being "Improvement in telegraphy;" observe, not telephony! There can be no doubt that Sir William heard the monosyllables "to be, or not to be," and "there's the rub." Nor can there be any doubt that Sir William tried to make the instrument speak in his laboratory at Glasgow, "but never got it to speak a word." It naturally occurs to my mind that Sir William was in ignorance of the arrangements of the connecting wires between the two instruments, or of some other essential matter, for it is really surprising that Sir William with his extensive knowledge should have failed to make an instrument repeat in Glasgow what he had seen or heard it do in Philadelphia. Can it be possible that Bell's instrument was merely a sort of improvement on the toy telephone which was the nuisance in the streets several years ago, called the "lovers' telephones," which did talk, but whose talking qualities were destroyed or curtailed by the supposed improvements by Bell. That instrument, without the magnets was, simply a "lover's telephone," and talks perfectly well if connected with a similar instrument by a thin thread.

I wish, for future reference, to make a point here. That this instrument of Bell's could not be made to talk by Sir William; and I here state that Bell's invention of a speaking telephone cannot be dated back further than October 9th, 1876, and I further state that the patent office of the United States furnishes indubitable evidence that the

description and drawings of a speaking telephone were filed in that office by James W. M'Donough, on April 10th, 1876, and that Bell's specifications and drawings, filed eight months after, present, I may say, a most remarkable similarity to those of M'Donough.

Sir William, being questioned in regard to the Morgan-Brown patent, speaks of the improved form of transmitter in which the goldbeaters' skin is replaced by the steel diaphragm, and of the improvement made in his receiver "by substituting instead of the iron tongue an iron or steel plate, and attaching all around its ridge to a solid body."

Here, then, we have the Bell receiver as now used and described for the first time in Morgan-Brown's patent of 9th December, 1876.

For the defence, Mr. Conrad Cooke and Professor Blyth were examined in chief, and cross-examined with great legal acumen by the Lord Advocate.

I do not deem it necessary to comment upon the statements made by those witnesses, for the reason that I cannot find any statement which establishes the fact of any prior publication of the use by Bell of "a plate of iron or steel, or other material capable of inductive action," as set forth in the eleventh claim in Morgan-Brown's original patent of 9th December, 1876, and in the sixth claim in the disclaimers, files on February 13th, 1878.

It seems to me that much time was lost in the examinations and cross-examinations of the witnesses of the complainants as well as of the respondent on the several publications referred to by the respondent's witnesses, as prior publications which would invalidate Morgan-Brown's patent of December 9th, 1876, in the face of the fact that the respondent had in his possession indubitable evidence of the publication of Bell's United States patent, No. 174,465, dated March 6th, 1876, in the official *Gazette* of the United States Patent Office, Vol. IX., published on March 6th, 1876, and on files in the British Patent Office on July 3rd, 1876, five months before the filing of Morgan-Brown's specifications on the 9th December, 1876.

That publication set forth the claims of Bell as follows:—

Having described my invention, what I claim, and desire to secure by letters-patent, is as follows:—

1. A system of telegraphy in which the receiver is set in vibration by the employment of undulatory currents of electricity, substantially as set forth.

2. The combination, substantially as set forth, of a permanent magnet or other body capable of inductive action, with a closed circuit, so that the vibration of the one shall occasion electrical undulations in the other, or in itself, and this I claim whether the permanent magnet be set in vibration in the neighbourhood of the conducting-wire forming the circuit, or whether the conducting-wire be set in vibration in the neighbourhood of the permanent magnet, or whether the conducting-wire and the permanent magnet both simultaneously be set in vibration in each other's neighbourhood.

3. The method of producing undulations in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration or motion of the conducting-wire itself in the neighbourhood of such bodies, as set forth.

4. The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing and diminishing the power of the battery, as set forth.

5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth.

I invite a comparison of the above claims with those in Morgan-Brown's English patent of December 9th, 1876, which are as follows:—

"First. The combination, substantially as set forth and described respectively in the fourth and fifth plans before referred to, but subject always to the disclaiming notes of a permanent magnet (or other body capable of inductive action) with a closed circuit, so that the vibration of the one shall occasion electrical undulations in the other or in itself; and this I claim whether the permanent magnet be set in vibration in the neighbourhood of the conducting wire forming the circuit, or whether the conducting wire is set in vibration in the neighbourhood of the permanent magnet, or whether the conducting wire and the permanent magnet, both simultaneously, be set in vibration in each other's neighbourhood.

"Second. The method of transmitting vocal or other sounds electrically by causing the intensity of an electrical current generated as and described in the fourth and fifth plans, but subject always to the disclaiming notes to vary in a manner proportional to the variations of density produced in the air by the said sounds.

"Third. The method of transmitting vocal or other sounds electrically by causing the intensity and polarity of an electrical current generated as described in the fourth and fifth plans, but subject always to the disclaiming notes, to vary in a manner proportional to the velocity and the direction of motion of the particles of air during the production of the sounds.

"Fourth. The union upon and by means of an electric circuit of two or more telephones when constructed for operation, substantially as described in the fourth and fifth plans, but subject always to the disclaiming notes, so that if the plate armature of any one of the said instruments be moved in any manner the armatures of all the other telephones upon the same circuit will be moved in like manner; and if the transmitter armature be moved or vibrated by sound, like sounds will be produced by the motion or vibration of the armature of the other telephones upon the circuit.

"Fifth. In a system of electric telegraph or telephony (consisting of transmitting and receiving instruments, such as were described in are the fourth and fifth plans, but subject always to the disclaiming notes, united upon an electric circuit) I claim the production in the armature of each receiving instrument of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet; and hence I claim the production of any given sound or sounds from the armature of the receiving instruments, such as are above mentioned by subjecting said armature to an attraction varying in intensity in such manner as to throw the armature into that form of vibration which characterises the given sound or sounds.

"Sixth. The combination in the manner described in the fourth and fifth plans, but subject always to the disclaiming notes, of an electro-magnet with a plate of iron or steel or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet.

"Seventh. In an electric telephone the combination with the plate of a magnet having coils upon the end or ends of the magnet nearest the plate, substantially as described in the fourth and fifth plans, but subject always to the disclaiming notes.

"Eighth. In an electric telephone the combination with a permanent magnet and plate armature of a soft iron pole piece forming the core for the coil, substantially as described" in the fourth and fifth plans, but subject always to the disclaiming notes.

I might quote also from the same number of the official *Gazette* the patents No. 175,971, filed by Bell 11th April, 1876, and No. 178,399, filed on 8th April, 1876; but it would be a waste of time to multiply proofs of the fact that several of the claims of Morgan-Brown's patent of 9th December, 1876, are set forth in the United States patent, notably the first claim in his disclaimer, which is word for word the same as the second claim of the United States patent, and the second and third claims which are embodied in the third claim of the United States patent.

It is, I believe, the settled law of Great Britain that a prior publication within her Majesty's European dominions of any material part of letters-patent invalidates and renders null and void the letters-patent; and the only means for the patentee to save what is left in his letters-patent, if there be anything worth saving, is to obtain the fiat of the Attorney-General to file a disclaimer and memorandum of alteration; and until this has been done a judgment for infringement of the patent cannot be obtained; and any suit brought against a person for infringement must be dismissed with costs against the plaintiffs. When a disclaimer and memorandum of amendment shall have been approved by the Attorney-General and filed at the Patent Office by Morgan-Brown, there can remain only the sixth, seventh, and eighth claims.

The sixth claim is the soul of the invention, namely, an iron or steel plate in front of the pole or magnet, but not in contact therewith, and attaching all around its edge to a solid body, as described by Sir William Thomson.

With a few remarks on the judgment given by Lord M'Laren in respect to the Morgan-Brown patent, I will close this lengthy communication with the intention of addressing you anon on the subject of Edison's patents.

With due deference to the Ermine I beg leave to say that the statement made by Lord M'Laren in his decision that "nobody but Sir William Thomson and Bell himself knew that the transmission of the electric current was to be in a closed circuit," is positively at variance with the fact established by the publication on 6th March, 1876, of Bell's U. S. patent, in which, as will be seen by reference to the second claim in said patent, a "closed circuit" and "electrical undulation," are set forth.

And, again, I beg leave to call in question the statement of Lord M'Laren that "it is not disputed that Bell is the first and true inventor of the telephone." This statement is simply a begging of the question, which might be expected to come from an advocate, but from a judge it seems rather unbecoming. With his present knowledge of the invention Lord M'Laren may be pardoned for entertaining

the opinion that Bell is the true inventor of the telephone, but not that Bell's claim is undisputed, and his lordship will soon have before him indisputable evidence that Bell did not invent a speaking telephone until eight months after a speaking telephone was invented, and full description and drawings thereof had been filed in the United States patent office. Yours,

London, *Feb. 14th*, 1882. W. C. BARNEY.

ELECTRICAL MAGNITUDES.

To the Editor of THE ELECTRICAL REVIEW.

DEAR SIR,—In reading *The Electrical Review* for December 15th, 1881, I found a slight mistake in Mr. Preece's article, page 506. This undoubtedly is a careless mistake, but on account of its importance, it seems to me that it ought to be corrected. We have

$$H = \frac{C^2RT}{J} = \frac{10^{-2}\,10^{9}}{4{\cdot}2\times10^{7}} = {\cdot}24$$

since one weber $= 10^{-1}$ in absolute measure
and „ ohm $= 10^{9}$ „ „ „
and „ J $= 10^{7}\times4{\cdot}2$ „ „ „

Therefore one weber would raise ·24 grs. of water one degree centigrade in one second, instead of 2405 grs. 1° C. in one second. Yours very truly,

ANTHONY C. WHITE.

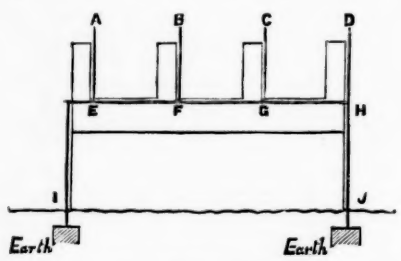
Institute of Technology, Boston, Mass.,
January 29th, 1882.

VYLE'S EASILY-TESTED LIGHTNING CONDUCTORS.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Permit me to express the pleasure I feel at the fair field accorded to me in this discussion, and as you have gone to the expense of an illustration to make matters clearer, I will at once deal with your test case as the point of most interest.

The sketch given shows four "spirelets" or "points" rising from two main conductors, or, if you like, one main conductor, with two earths. My method of dealing with



these would be a saving of the conductor running between F and G. I would treat each earth as the end of a separate conductor, and so starting from the left hand side at I, carry the conductor to the bottom of the "point" on A, where, *without disturbing the testing wire*, the conductor proper would have a soldered connection with said point; the conductor being carried forward by E to F and B, where the testing wire would be joined to the conductor in the usual way, forming what might be called conductor No. 1. On this a small three-terminal test-box would be placed just above the letter I. Commencing now with conductor No. 2 at J, and taking it by H to the foot of "point," D, the connection with the outer cable would be made, as at A, and extended by G to C, where it would be connected to the testing wire. The four chimneys would thus be furnished each with its own conductor, and all could be tested. But suppose the extreme case you mention of "test wires from each of the points," or, in other words, four complete and separate conductors for the four chimneys, then the cross section saved would nearly form another conductor, whilst the fourth could be met by the saving on broken slates and damaged chimneys which frequent visits to the roof for periodic testing would entail. It would be interesting if you, Sir, would indicate how, without cutting your conductor, you would propose testing it and the four spirelets, with an estimate of the cost for repairing damage to roof.

In reference to the courteous letter of an "Electrician," I would remark that the question he raises is a very fair one, yet whilst it is within the province of the possible, is scarcely probable. An insulated wire that might be broken inside is hardly likely at the same time to make good metallic contact with the outer cable. The copper staples that are driven into the wall are of the letter Y pattern, with the short ends rounded. The conductor, when placed within the two short arms, has the ends bent over without the need for rough hammering. But supposing the inner wire did make this good contact near the top, it would be evidenced in the test made before leaving the conductor after fixing. As, contrary to "Electrician's" opinion, I have a testing apparatus of great delicacy specially for testing lightning conductors, and in such a case as he has referred to would be used. The bell test referred to in my last letter would be the usual one applied, and that showing the conductor or testing wire failing on short circuit, would lead to inquiry and careful tests of the most delicate kind. However, as the matter has been raised, a simple remedy could be applied by inserting at the top some few ohms resistance. To those who have good conductors of the ordinary kind, the principle of my conductor for testing purposes can be applied, as before the idea of making the conductor protect the testing wire, I had adopted the plan of using a fixed wire—either insulated by percha, &c., or by a bare wire supported by insulators nearly alongside—which is included in my patent specification. The double conductor has the disadvantage that for testing purposes the side you want to use for your testing wire is not insulated, and consequently the current may never reach the top, to go down the other side. In the large number of chimneys with iron bands around them, the testing current would not pass beyond the first band, where it would be short-circuited. Unless you can insulate the wire conveying the current to the top of the conductor, you cannot hope to get a proper test.

The necessity for testing conductors is pointed out—nay, is *urged*—by all authorities, and it behoves us to find out the best way to do it. Conductors are valuable in proportion to their efficiency. Their efficiency can only be known by an electrical test. An electrical test can only be applied by first getting an insulated wire from the ground to the top. The question is, what is the best means of effecting this? I have simply made an attempt to solve it in the principle of my conductor. How great the need for testing is will be comprehended somewhat when I say that at West Hartlepool in a ten minutes' walk I found a tall chimney with a faulty, valueless conductor; a church with a spire with bad joint, and a chapel boasting a spire, with the first 6 feet of the conductor above ground, cut clean off! What would a universal inspection reveal?

Yours very truly,

SAMUEL VYLE.

22, Borough Road, Middlesbro',
11th February, 1882.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.—FEBRUARY 11th.

ANNUAL GENERAL MEETING.

Prof. W. GRYLLS ADAMS in the Chair.

THE PRESIDENT read the report of the council for the past year, from which it appeared that in this, the tenth year of the society, it was in a highly satisfactory condition, and numbered 331 members. Sir Charles Wheatstone's papers had been published; Dr. Joule's were soon to be so; and delegates from the society had taken part in the Electrical Congress at Paris, the Lightning Rod Committee, &c.

The TREASURER (Dr. Atkinson) read the audited report

of the financial state of the society; and the following officers were, after a ballot, declared elected for the ensuing year:—President, Prof. R. B. Clifton, F.R.S.; vice-president (past-president), Sir William Thomson; vice-presidents, Prof. G. C. Foster, Prof. F. Fuller, Dr. J. Hopkinson, Lord Rayleigh; secretaries, Prof. A. W. Reinold, Prof. W. Chandler Roberts; treasurer, Dr. E. Atkinson; demonstrator, Prof. F. Guthrie; other members of council, Prof. W. G. Adams, Prof. W. E. Ayrton, Mr. Shelford Bidwell, Mr. Walter Baily, Prof. J. A. Fleming, Mr. R. J. Leeky, Dr. Hugo Müller; Prof. Osborne Reynolds, Prof. A. W. Rücker; honorary member, Prof. G. Quincke.

Votes of thanks were then passed to the Lords Commissioners of the Committee of Council on Education for the use of the Meeting Hall, to the past-president, Sir William Thomson, to the secretaries, the treasurer, and demonstrator, as well as to the auditors, Mr. Shelford Bidwell and Mr. G. Rigg.

Prof. ADAMS then resolved the meeting into an ordinary one, and called Prof. Clifton to the chair,

Dr. C. R. ALDER WRIGHT, F.R.S., then read a paper "On the Relation between the Electromotive Force of a Daniell Element and the Chemical Affinity involved in its Action." The author has investigated the causes which lead to a fall of E.M.F. in a Daniell cell when in action. He found the amount of fall for increasing current densities and plotted it in a curve. The fall was slight when pure commercial or amalgamated zinc, or zinc coated with a film of copper, was employed. Dilute sulphuric acid round the zinc also gave a less rapid fall than sulphate of zinc solution round it. In all cases no appreciable fall was noticed when the current did not exceed 8 microampères per square centimetre of plate surface. With 4 to 6 times this density a decrease of E.M.F. from 0·5 to 1 per cent. resulted, and with currents exceeding 3,000 microampères in density per square centimetre of surface the fall exceeded 10 per cent.

A series of experiments were made to determine the fall, due to change in the density of the solutions by migration of the ions causing a stronger zinc and a weaker copper solution. These showed that with nearly saturated zinc sulphate solution (sp. gr. 1·4) and very dilute copper sulphate solution the maximum fall in E.M.F. is developed and is less than ·04 volts, hence the total fall in E.M.F. due to migration of the ions when moderately strong currents pass is only a fraction of the total fall. It follows that the energy due to the actions taking place in the cell, although wholly manifested in electric action expressible in volt-coulombs when the current is very small is not wholly so manifested when the current is stronger; the author expresses this idea by calling the energy manifested in electric action *adjuvant* and the remainder as *non-adjuvant*. He finds that the major part of the latter energy is absorbed in actions having their seat at the surface of the copper plate, and the rest in actions at the surface of the zinc plate. It is transformed into heat according to Joule's law. As a subsidiary result it appears that the E.M.F. of a Daniell cell, with zinc and copper sulphate solutions of equal specific gravity, a pure amalgamated zinc plate, and either a freshly deposited copper or an amalgamated copper plate, is a standard subject to less departure from the E.M.F. of other Daniell cells than the Clark's standard elements, which appear to vary one from another. On the other hand, a Clark cell keeps sensibly constant to its original value (if properly set up) during a period of months or years at a constant temperature, whereas a Daniell standard falls from its original value after a few hours, or days, at most.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this society was held on the 9th inst., Lieut.-Col. WEBBER, R.E., president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed members read, it was announced that the report of the Lightning Rod Conference, which had been partially drawn up by the society, had been published, and could be obtained by members for 5s., or two-thirds the published price. The president then stated that Mr. J. Aylmer, the secretary to the British section at the late Paris Exhibition, had presented the society with a collection of photographs illustrative of the same.

A paper was then read by Mr. H. F. JOEL on the "Pilsen Electric Arc Lamp." This lamp, which has been described in the number of the *Journal* for Dec. 15, 1880, was exhibited in action, and the latest improvements in the same and the various modifications, were fully explained. In conclusion Mr. Joel claimed, as advantages in this lamp, its great steadiness and simplicity; the absence of clutches rendered it very sensitive.

In the short discussion which followed the reading of the paper, Mr. A. Siemens and Professor Ayrton took part. The usual vote of thanks having been proposed and seconded, the meeting then adjourned.

NEW PATENTS—1882.

607. "Telephone transmitters." R. and M. THEILER. Dated Feb. 8.

616. "Machinery or apparatus for purifying middlings (using plates with electrified surface)." *Complete.* W. R. LAKE. (Communicated by the Electric Purifier Company.) Dated Feb. 8.

621. "Improved system or means of effecting and maintaining the continuity of divided and subdivided electric currents for lighting purposes without possible disruption between stations however numerous or distant apart." J. B. ROGERS. Dated Feb. 8.

626. "Electric lamps." A. A. COMMON. Dated Feb. 9.

632. "Improved means of and apparatus for signalling by electricity on railways." S. C. C. CURRIE. Dated Feb. 9.

661. "Improvements in telephone exchange system and apparatus, part of which improvements is also applicable to other similar purposes." H. H. ELDRED. (Partly communicated by T. B. Doolittle.) Dated Feb. 11.

677. "Improvements in interlocking electric and other signalling apparatus for railway and other traffic. Particularly applicable to existing forms of electric railway signalling apparatus." W. E. LANGDON. Dated Feb. 11.

686. "Telephone call or signalling apparatus." A. M. CLARK. (Communicated by G. M. Hopkins.) Dated Feb. 11.

687. "Improvements in and relating to telephonic exchange systems and in apparatus employed therein." A. M. CLARK. (Communicated by G. M. Hopkins.) Dated Feb. 11.

688. "Improvements in the method of transmitting or reproducing and repeating sounds by electricity, in the method of destroying the effects of induction in a telephonic line, and in telephonic transmitting and repeating apparatus." A. M. CLARK. (Communicated by G. M. Hopkins.) Dated Feb. 11.

689. "Telephone receivers." A. M. CLARK. (Communicated by G. M. Hopkins.) Dated Feb. 11.

700. "Generation, storage, and utilisation of electricity and apparatus, or means to be used therefor or in connection therewith for lighting, heating, and other purposes." J. S. WILLIAMS. Dated Feb. 13.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

[Through pressure on our space we are compelled to omit from this number the usual list of specifications published.—EDIT. ELEC. REV.]

CITY NOTES.

OLD BROAD STREET.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED.

THE ordinary general half-yearly meeting of the proprietors of the above company was held in Cannon Street Hotel on the 10th inst. The Right Hon. Viscount Monck presiding.

The Secretary, Mr. T. H. Wells, having read the notice convening the meeting, the minutes of the last meeting were read and confirmed.

The Chairman said: "Gentlemen,—I presume you will take the report (see *Electrical Review*, issue February 11th) and statement of accounts, as usual, as read, and in moving the adoption of the report it will be my duty, as usual, to make a few observations upon the report itself and upon the present state of your company. Of course the most important considerations on these occasions is the condition of the property by means of which you earn your income. I am happy to be able to inform you that your cables are all in good working condition. You will observe in the report that one of our

cables was broken close to the shore at Valentia in one of the great storms that occurred last autumn. I am happy to tell you that since the report was printed the cable has been restored to working condition, and is now doing its duty equally with the rest of your cables. The state of the weather was referred to in the report, and it was also referred to in an important State document which came before the public a few days ago. A good deal of fun (to use a homely phrase) was poked at her Majesty's Government for informing the legislature that fine weather was favourable to agriculture. Still, we tell you in like manner that bad weather—storms, &c.—are unfavourable to our particular branch of business. They are injurious, too, in two ways—first, mechanically, because we find that the action of the waves in shoal water has a great tendency to fray the cables and to destroy their efficiency; and that actually occurred the other day in the case of the 1874 cable, the repair of which I have just announced to you. But there is another mode by which storms as atmospherical disturbances affect our cables very much, and that is by the effect they have on the electrical conductivity of the cables. When the atmosphere becomes surcharged with electricity, it very often happens that the electrical conductivity of our cables is either diminished or possibly wholly destroyed. Luckily, we have escaped anything of the kind this year, but on former occasions it has occurred, and it may occur again. I think, gentlemen, that the state of your cable is a matter of congratulation. I would remind you that one of your cables, which is still working in perfect efficiency, viz., the French cable from Brest and St. Pierre, has now been nearly 13 years under the ocean. I believe I am correct in stating that it is the oldest Atlantic cable in existence; I mean, of course, in operation, and that it has lasted longer than any other Atlantic cable that has been laid down. You will see by the report that we have been obliged this year to take a fault out of the cable; and we lifted the cable in 1,700 fathoms of water. I think if a cable that has been down 13 years be still capable of being lifted in such a depth of water, it shows just matter of congratulation, and shows that the cable must have been originally of very good stuff (hear, hear). So much, gentlemen, for the state of your property. I now come to the accounts for the half-year, and as I have often stated to you the true mode of comparison is not to compare the accounts of two successive half-years, but to compare the accounts of the corresponding halves of each year, because there are circumstances which cause a little disparity between the autumn and the spring half-year. There is very little difference between the amounts of the accounts, the expenditure of the half-year, considering the increased business is much the same as that of the corresponding period. With regard to the income for the year, it is absolutely impossible to institute any comparison, for this obvious reason, that we have been for the last two years, so to speak, jumping about from one tariff to another, a state of things which has been induced by circumstances to which I will presently allude. The circumstance is the competition to which we have been subjected, so that really no fair or satisfactory comparison can be instituted between the two half years. I may, however, mention to you that we have had a shilling tariff in operation since 1st August last; and as you will see in the accounts, the receipts for the shilling tariff have not, by any means, recouped the loss which going from the three shilling tariff has brought upon us, the results, however, so fas as they go are very satisfactory. As stated in paragraph 9 of the report, the net receipts of the three companies interested in the reduced rate have averaged £1,674 per day for five months, and it shows an increase of £801 per day, or an increase equal to about 92 per cent. Since the last trial we had of a shilling tariff, which was in 1877, only about five years ago, that is certainly an enormous increase, and I think to a great extent justifies my opinion with reference to the maintenance of the very low tariff, as to which I shall have something to say presently. We reduced our tariff to one shilling on August 1st. The primary motive for the reduction undoubtedly was the new competition which had arisen in the United States by reason of the formation of a company which had been brought into existence by Mr. Jay-Gould. That change was announced at your last half-yearly meeting, and the primary object was, as I say, to use it as fighting tariff. At the same time your directors thought that having already made three arrangements with other companies, which had sprung into existence, it was time they should adopt measures for informing themselves thoroughly what the effect of a low tariff would be on the traffic, *i.e.*, whether they could count on such an increase of traffic at a low tariff as would fill all the cables and give an opportunity of making an income to all parties concerned. Of course, it is obvious that there are two alternative systems of policy to be adopted when competition arises. You may on the one hand make an arrangement with your new competitors and give them by agreement a portion of the income. Well, gentlemen, that is the principle upon which we have hitherto operated. That principle has hitherto been the foundation of our policy. It undoubtedly has the recommendation that you can by means of it keep your tariff up, and as the traffic—even with a higher tariff—has a normal and natural increase you may be able, though only receiving part of the gross income, to divide and reap good dividend. But, gentlemen, I must remaind you that this consideration has a limit. You cannot go on for ever dividing the gross receipts, and by keeping your tariff up you very materially prevent the increase which we have seen is taking place in our income under a low tariff. These are the considerations for and against the principle which has hitherto guided our policy. We have now to consider what would be the probable effect of adopting the opposite policy *i.e.*, the policy of declining any further amalgamation or arrangement with competitors, and going in for a low tariff, endeavouring by that means so to stimulate the traffic as to produce trade which would fill all the cables in existence, and so get rid of competition by the opposite means from that by which we seek to neutralise it by agreement. It is fair to say at once that the desire to obtain information which would enable us to arrive at a sound conclusion on this question was one of the motives which induced your directors to put down the tariff on the 1st August. It is equally right that I should tell you at once that we do not think that the period for which the tariff has been in operation is sufficiently long to justify us in arriving at any conclusion as to whether it ought to be the base of our future policy or not. I have now been for some eight or nine years chairman of your company, and I am bound to say that during the whole time we have been seldom out of hot water. (Laughter.) Whatever may be the inducements which impel capitalists to bring new cables into operation, they seem to be so overpowering that no consideration of probable profit or loss will deter them from embarking in these enterprises. Well, gentlemen, on former occasions when we have had this same kind of trouble on our hands, I have appealed to you for confidence in your directors, and I am bound to say that I have never made that appeal in vain. I hope and trust that the conduct of your directors, and their endeavours to maintain your interests, have been such as to justify you in your own minds in the confidence you have reposed in them. I am about to make a similar appeal on the present occasion. We are in presence of a great contest with a gigantic financial company in the United States, and any indiscretion on our part, either in word or deed, may very materially influence the effect which that contest may have upon your interests. I do not want to have any reserve with you. I have told you plainly what we are aiming at, but I do ask you, if you trust us as your directors, to trust us wholly, and to allow us to exercise the best judgment we can in the management of this great contest (hear, hear). Now, gentlemen, passing from that subject, I may mention that I have received letters from several shareholders in our company directing my attention to the great diminution that has taken place in the value of your property in the market, and suggesting means by which that should be neutralised. Now, I need not tell you that if your directors could by any means prevent the depreciation of your property in the market, nothing would give them greater pleasure. But unfortunately it is these continued competitions to which I have already referred which afford the true reasons for that depreciation, and over them, it is obvious, we can have no control. A suggestion has been made in one or two letters which I have received, and I may take this opportunity of saying that if I have neglected to answer some of these letters it is from no want of courtesy to the gentlemen who write them, but because I think it is better to give my answer in public to the shareholders generally (hear, hear). I was going to say that a suggestion had been made that our reserve fund should be made use of to purchase in the market a large amount of our own stock and to cancel it, the intention, of course, being to increase the value of the residuum by diminishing the quantity of stock in the market. Now there is one answer to that, which is that it would be inconsistent with our articles of association for the directors to do anything of the sort (hear, hear). It is quite true there is a short answer to that—that the shareholders, if they wished it, could change the articles of association, but I would beg to call the serious attention of the shareholders to what the effect of such a change would be. It would give to your directors the power of jobbing in the market with your shares, and you may rely upon it that every fall or every rise in your shares would be attributed to sinister action on the part of your directors. I do not believe that Aristides himself, if he were still in existence, could maintain his character against the insinuations which would be thrown upon us under such circumstances (hear, hear). I confess that I would go a long way, and submit to any amount of labour, and undertake a great deul of responsibility to promote the interests of the company with which I have had so many pleasant associations as I have with this; but I honestly confess I do not think I could incur the responsibility of undertaking such operations as that: so much for that consideration. I do not know that I have anything else of any great consequence to say to you. I have endeavoured to lay before you, without exaggeration and without reserve, the state of your enterprise, and the principles upon which your directors hope to manage it in the future as they have in the past. I can assure you (and I speak not only for myself, but for all my colleagues) that our sole object is the maintenance of your property, and the improvement of it so far as they are able to effect improvement, so as to make it more valuable in the market and more productive to the shareholders of the company (applause). Gentlemen, I beg leave to move the adoption of the report.

The Hon. R. Grimston seconded.

Mr. Smith asked if any information could be given about the steamship *Faraday*, which had been sent out to relay. No news had been heard of her for four or five weeks.

The Chairman said that he knew nothing about her.

Mr. Smith, continuing, further asked whether repairs for the past year had been made out of income or taken from the reserve fund, and since when the duplex system had been applied to their cables; also if the Direct or French cables were silent, and, if so, for how long a time did they take their proportion of revenue. He had also an amendment to make on a certain portion of the report, and he accordingly begged to move "That the directors be directed to declare a final dividend, free of income tax, of 2s. per cent. on the ordinary stock, 10s. per cent. on the preferred stock, and 40s. per cent. on the deferred stock, amounting altogether to £87,500, carrying to reserve fund £2,500." (Laughter.)

The Chairman said that under the articles of association he could not put that resolution from the chair. The shareholders could reduce the dividend, but could not increase it.

Mr. Smith objected to such a clause altogether, and certainly thought that no good purpose was served by building up such a large reserve at the expense of dividend.

Mr. Weir would like to know the average increase or decrease since the introduction of the shilling tariff (hear, hear).

Mr. Dennison would have liked to second Mr. Smith's motion. He thought £300,000 a perfectly sufficient reserve fund.

Mr. Priest asked how much had been spent in fighting the Jay-

Gould Company? And then went on to refer, amidst considerable demonstration, to the directors' fees, which he thought should be reduced.

A Shareholder asked to how much the reserved fund would be increased.

Another Shareholder considered that the reserve was not at all too great, and should not like it to be trenched on for the purpose of dividend. (Applause.)

Mr. Griffiths said that the shareholder had at least the power of recommending that the board should increase the dividend. 3½ per cent. was surely a small return. He was astonished that five months' experience of the 1s. tariff had not been sufficient to enable the board to determine whether it could be maintained, and he also thought they had reduced the tariff much too hastily. Remembering the difficulties attendant on the laying of cables, they should have waited to see how Jay-Gould's Company succeeded.

Mr. Jackson, who said he was an original shareholder of the company, was not prepared to agree with Mr. Smith's recommendation. The very worst time to depreciate their reserve fund was at the verge of a possible war. An increased dividend out of the reserve was a fatal policy. (Applause.) He was certain that the meeting would support the board in this matter.

The Chairman said that the first question asked had been as to how the repairs made during the past year had been paid for. They had been paid entirely out of income, except that a portion of cable which they had in stock had been utilised. As to the duplex system, it had been first put on one of their cables in the year 1878, and then gradually extended to them all. In the event of a cessation of work on the part of any of the cables of the associated companies, he might say, without going into details, that the reductions made on that account were all reciprocal. Each company stood on the same footing with relation to the others. One gentleman, a deferred shareholder, had been disappointed at not getting more dividend. That was not to be wondered at; but he must remember that the deferred could only get—and they gave them as much as they could—what was left after paying the preferred and the ordinary stock. He did not think it was the opinion of the shareholders generally that they should starve the reserve fund in order to give the deferred shareholders a larger dividend. Another gentleman said that, as a deferred shareholder, he had received nothing for three years. Now, in 1876 the deferred shareholders received 3 per cent., in 1877 2 per cent., in 1878 5 per cent., in 1879 4 per cent., in 1880 ½ per cent., and this year they received 1 per cent. They were not very large dividends, but they were a good deal different from nothing. As to the observations made upon the directors' salaries, he did not think that, standing as he had done for so long a time before these meetings, he need be expected to say anything upon the matter. (Applause.)

Mr. Priest said that he had asked his lordship whether he would give them the expenditure from one half year to another.

The Chairman said he supposed Mr. Priest had the report for the last half year himself. If he had not, they would send him one from the office, and he could make the comparison himself. Continuing his remarks, his lordship said that as to their having reduced the tariff at too early a period, he thought he had made it pretty plain that even if they had adopted a low rate as a fighting tariff, they were bound to start at the earliest possible moment. Fifteen or twenty years ago there were many uncertainties and difficulties in laying a cable across the Atlantic, but from the great advance in scientific knowledge and precision, the laying of a cable across the Atlantic was almost as great a certainty as making a tramway in one of the streets of London. It would have been absurd for any board like theirs to have delayed such a measure as the lowering of their tariff because twenty years ago it was a difficult thing to lay a cable across the Atlantic. Mr. Jay-Gould and his colleagues had not been very successful, but they had no right to expect that, and without wishing to disavow responsibility in any degree for what this board had done, he would remind the shareholders that the announcement of their intended reduction of tariff was made at last half-yearly meeting. In fact, that meeting was held after the reduction. It was well known they were going to make it, and there was not the slightest objection made in the room. His views on the reserve fund, a matter that had been referred to by more than one gentleman, were pretty well known, and so far as he was concerned he had nothing to retract from what he had said on the subject. It would simply be disgusting the meeting to hear over again from his lips the mere facts and arguments which he had so often brought before them, but there was one gentleman at their board who had probably more experience, or at least as much as any gentleman living, on the matter, and he would call upon Mr. Grimston to say a few words on the subject of the renewal fund.

Mr. Newton said that there had been a block in the Anglo-American line since the shilling tariff had been established. He thought for that reason that there should be a higher tariff, in order that there might be a system of express and slow messages. He wished to correct a statement which had been made with reference to Mr. Griffiths. That gentleman *had* disapproved the lowered tariff at last meeting. He (Mr. Newton) well recollected it, because he cordially approved of it, and was delighted to see that they had at last a fighting tariff. He was certain that sooner or later they would have to fight in the Atlantic Ocean for the supremacy of the Anglo-American Telegraph Company—they must fight, and as surely as they fought would they win. They had the complete monopoly of an enormous traffic which nothing could upset, and the longer they fought the greater would be their victory. He would like to know where the break had occurred in Mr. Jay-Gould's cable (Laughter). He knew they could not have it officially from the chairman, but the chairman could tell them where it was said to be, because the directors, of course, knew a great deal more than the shareholders did. In proportion to his means he had a large sum invested in cables, and he should like to know where the break was, because if it was in deep ocean he was satisfied they would have some difficulty in fishing it up. Then as to the other cable, it would, he thought, be well if they could have some information as to how much of it was laid, and what progress was being made.

The Chairman said that if he had done Mr. Griffiths any injustice in saying he approved of the shilling tariff at last meeting he had only to apologise to him, but what he had really meant was that there was no effective opposition at that meeting. As to Mr. Jay-Gould's cable, he did not happen to be chairman of that company, and though Mr. Newton gave the board credit for possessing a great deal of knowledge, he had exceeded their powers on that occasion. They really knew nothing about it.

The Hon. R. Grimston said that maintenance was the first necessity of a telegraph company, because unless they had the line in good working order they had no revenue whatever. In a land telegraph maintenance was the first charge; and the only mode of maintaining a submarine cable was by laying aside a sufficient sum from time to time to replace it when worn out. (Applause.) Unless that was done, they were merely killing the goose that laid the golden eggs. He should have thought that all business men would agree that the only question was as to what amount should be put to a renewal fund, and on that question there would be much diversity of opinion, for no people seemed to be agreed about the life of the cables. The 1865 and 1866 cables both failed within ten years, but they were not defunct. Without having parted with a single shilling by raising debentures, or any other way, these cables had been replaced in the only legitimate way—out of revenue—and were now carrying 30,000 words or more a day! Pretty good work for defunct cables. (Applause.) When the 1869 cable came to be replaced, they would not require to go to the public for money. No; they would be able to go into the market with ready money in their hands, and then the 1869 cable would be as efficient as the defunct cable of 1865 and 1866. (Applause.) The capital of a company should be like the sovereign—it never dies. These views of his as to the proper maintenance of cables did not appear to be the same as those of some gentlemen who had spoken, but he had not heard one of them suggest any alternative for renewing their cables when worn out, or any substitue for the renewal fund. The company were laying by £150,000 a year, which was rather more than 2 per cent. on the capital, but they could not do less if their property was to be maintained. (Applause.) Any other course on the part of the directors would be suicidal to the concern, the whole life and existence of which depended upon its renewal fund. (Applause.)

Mr. Weaver, managing director, said there had been no block during the operation of the shilling tariff. The delay in transmission of messages between London and New York was not more than thirty minutes.

The motion for the approval of the report was then put to the meeting, and carried unanimously.

The retiring directors, Viscount Monck and Mr. Charles Crapelet were re-elected, as were also the auditors, Messrs. Joshua Dean and Francis Glass.

The proceedings were terminated by a vote of thanks to the chairman and directors, proposed by Mr. Griffiths, seconded by Mr. Jackson.

THE INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY, LIMITED.

THE eighteenth ordinary general meeting of the shareholders of this company took place on the 14th instant at the Cannon Street Hotel.

In the absence, through illness, of the chairman of the company (Mr. George Henderson), Mr. S. W. Silver presided.

The report, an abstract of which appeared in our last issue, having been taken as read, the chairman, after apologising for the absence of Mr. Henderson, said: It remains for me, in moving the adoption of a very satisfactory report, to refer to the items generally in it. I don't think there is need of very many remarks from the chair. The state of the accounts we consider to be of a very satisfactory nature, and for a trading concern to be able to set aside a dividend of £1 per share, in addition to 10s. a share paid as interim dividend last July, is a matter of congratulation. We have decided upon setting aside £25,000 to add to the reserve fund. I think that is an act of prudence on our part. We have had a good increase in our out-turn, and I may refer also with pleasure to the increase in our cable business. Our general business is going on satisfactorily, and there is nothing particularly to be referred to in that; but the contracts for cables this year have been larger than usual. As regards these, we are in a good position, as is proved by the fact that in twenty weeks we have produced 3,000 miles of cable, to the entire satisfaction of those who gave us the work to do. As manufacturers we only require a fair field and no favour. As we are all here partners in one concern, you must help us in our efforts. It is rather a close field, this contract business, and whilst my friend on my left is indefatigable in his exertions, and whilst we, and our chairman in particular, back him up in every way in our power, we want assistance from you. I hope you will render us such help as will keep up a satisfactory state of things for years to come. As regards the steamship *Silvertown*, the purchase of which you will see referred to in the report, that has rendered us independent of all outside help. We can now go forward and take any contract. It places us in a position we never occupied before. After these few remarks, I should say of our chairman, in his absence, that his watchful eye is ever over this concern, day by day, I might say hour by hour. We can say in his absence what we cannot so well say in his presence, that we are very much indebted to him. I am sorry he is not present here to express the satisfaction he feels at the present condition of the company. I shall be glad to hear anything that any shareholder may have to

say; I don't think that I need detain you longer, and I will conclude by moving that the report and accounts be received and adopted, and that a dividend of £1 per share free of income tax be now declared.

Mr. Bannatyne seconded the motion, which was carried unanimously.

Dr. Beattie was re-elected as a director of the company, on the motion of the chairman, seconded by Mr. Bannatyne.

Mr. Hanson, seconded by Mr. Horne, moved that Messrs. J. Weise and James Cowan be re-elected as auditors for the current year, at a remuneration of 30 guineas each. Carried unanimously.

The Chairman said he was going to ask them to join in expressing their thanks to their manager, Mr. Matthew Gray, for his oversight and attention to their business, as also to the very efficient staff which he had gathered together.

Mr. Randall seconded the motion, and in replying

Mr. Gray said that though they were enjoying a little success now they should not be carried away by too great hopes for the future. Their business at Persan had never been a very remunerative business. They had during the past year added to its power of production by erecting machinery and buildings suitable for subterranean cable work, and he was glad to say that the orders intrusted to them had been very successfully executed. Their india-rubber and general telegraph business at Silvertown had been gradually increasing, and as they stood they were really well able to meet all their competitors. They must endeavour by their superior production to place themselves in a position of advantage, and up to this moment indeed they had done so. The general business amounted to something like £300,000 a year, and it was fairly remunerative. He hoped that by attention they could increase the out-turn a little, and so add to the profit. Their cable business, as they knew, was a very fluctuating business. They had got their works now fitted up in such a way that he had no hesitation in saying that they could produce work equal in quality to any in existence, and at a moderate cost, and they were therefore in a fair way of being able to meet their competitors, provided there was a fair field and no favour. Their works were now capable of producing about 8,000 miles of cable in one year. They had two competitors, very able, very enterprising, who had to be met in almost every contract that they secured, and these competitors besides had friends who were able to supply them with orders without competition. Any one of the three manufacturers was able to produce in one year more cable than was wanted throughout the world, if constantly employed. If they asked, why then were they increasing their machinery, he could tell them that the reason was that their cable contracts had to be carried out in so short a time that they must buy machinery to complete them in what their customers termed reasonable time. He asked them to be careful in estimating their future position. They should not be over sanguine; the staff would do their best, and endeavour to maintain the position they had hitherto occupied, but shareholders must bear in mind that they had able and energetic competitors, who had to be met at every turn, though it was with no coward heart that he looked forward to the future. Their staff was a very good one, they had done well in the past, and he thought that with average fortune they would not in the future fail in anything intrusted to them. He thanked the meeting very cordially for their vote of thanks.

Mr. Bakewell, seconded by Mr. Treble, moved a vote of thanks to the chairman and the board of directors, which was carried unanimously.

The chairman briefly responded, and the proceedings then terminated.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—The report of the directors for the six months ending 31st December, 1881, to be presented at the ninth ordinary general meeting of the company, held as we go to press, states that for the half-year the revenue, after deducting out-payments, amounted to £64,514 4s. 4d. against £59,815 6s. 5d. (after similar deductions) for the corresponding half-year of 1880, being a difference of £4,698 17s. 11d. in favour of the half-year under review. The working and other expenses, including interest on debentures, amounted to £25,574 10s. 2d. leaving a balance of £38,939 14s. 2d. as the net profit of the half-year, making, with £7,179 10s. 8d. brought forward from the previous half-year, a total balance of £46,119 4s. 10d. For the corresponding half-year of 1880, the working expenses and other payments amounted to £26,233 8s. 11d. Interim dividends of 1¼ per cent. each for the quarter ending 30th September, 1881, paid 16th November, 1881, and for quarter ending 31st December, 1881, payable 16th February, 1882, together amounting to £30,355, have been declared. The cables are now, and have been since the last report, in good working order. The Muirhead duplex system, which has for some time been in operation on the main cable, has also been applied to the short cable, and with equal success in increasing the carrying capacity. The reduced cable tariff of one shilling per word has been in force since the 1st August last. The traffic, so far, has not responded to the reduced rate.

THE MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).—The report of the directors of this company to be read at the forty-ninth ordinary general meeting, to be held on Monday, the 20th of February, 1882, states, that the half-year's balance sheet, taken together with the previous one, shows an increase of the company's business over that of the preceding twelvemonth of £1,091, which has reduced by that amount the claim on H. M. Treasury. A very small expenditure has sufficed to maintain the cables in efficient working order. It is proposed by the directors to pay the usual dividend on the preference stock at the rate of 8 per cent. per annum, less income tax, and on the ordinary stock at the rate of 3 per cent. per annum, free of income tax, payable on and after the 1st proximo, which will leave £471 13s. 4d. to be added to the reserve fund.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The directors of this company, subject to the audit of the accounts, propose paying a dividend of 15 per cent. (£1 16s. per share), in addition to the *ad interim* dividend of 5 per cent. already paid, making 20 per cent. for the year 1881.

THE EASTERN TELEGRAPH COMPANY (LIMITED) notifies that during the interruption of the Hongkong—Amoy and Amoy—Shanghai cables, telegrams for Amoy can only be accepted to go by post from Hongkong at daybreak on Wednesday, 15th inst. Telegrams to catch this mail should be despatched not later than 5 p.m. on Tuesday, 14th inst.

THE GREAT NORTHERN TELEGRAPH COMPANY'S cables between Shanghai and Amoy, and between Amoy and Hongkong are interrupted. Telegrams for Hongkong, Amoy, and Manila cannot, therefore, be accepted by this company. Until the restoration of the above cables, this company's route is the only route to Japan, Shanghai, and all stations in China north of Shanghai.

THE JAY-GOULD CABLES.—It is rumoured that the *Faraday* has been fortunate enough to pick up one of the Jay-Gould cables, and to communicate through to the Hut at Whitesand Bay.

THE INDIA-RUBBER AND GUTTA-PERCHA COMPANY'S S.S. *Silvertown*, &c.—The *Silvertown* moved into the Albert Dock on Tuesday, the 7th inst., to complete the alterations now being carried on. A telegram from Mr. King (in charge of the *Dacia*) announces the successful landing of the shore-ends at Payta, of the Chorillos-Payta and Payta-Sta Elena sections of the Central and South American Telegraph Company's cables.

THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.—A telegram was received on Thursday last by the Silvertown Company, announcing the successful laying of the Sta. Elena-Payta section of above company's cables.

NEW COMPANIES.

ELECTRICAL TRADING.—Offices: 2, Victoria-mansions, Westminster. Objects: To carry on the business of manufacturers of electrical and other apparatus, and to purchase certain patent rights enjoyed by C. V. Boys, of Wing, near Oakham, and J. G. Lorrain, of 2, Victoria Mansions. Purchase consideration £5,100—£100 in cash, and the residue in deferred shares. Capital £10,000 in £10 shares. Signatories (with one share each): R. Knight, 11, Haroldstone-road, Kensington; L. Milne, 115, St. George's-road, S.W.; W. Cross, Pimlico, S.W.; L. S. Powell, 56, St. James's-square, W.; L. B. Miller, 31, Darnley-road, Hackney; A. Muirhead, 8, Victoria-chambers, S.W.; J. T. Glass, 60, Ashmore-road, W. Also directors: R. W. M. Fullerton, R. H. Home, C. V. Boys, and C. J. G. Lorrain. Qualification: The holding of ten shares. Registered February 1, 1882, by Messrs. Burton and Co., 37, Lincoln's-inn-fields.

GREAT NORTHERN ELECTRIC LIGHT COMPANY.—Objects: To acquire for New Southgate and adjacent districts the sole right to use for street lighting the Pilsen Arc Electric Lamp, and for churches, public buildings, and private residences the Joel semi-incandescent lamp, and the Schukert dynamo machine as a generating power. Capital £10,000, in £1 shares. Signatories (with one share each, and of New Southgate, unless otherwise specified): H. E. Harris, 66, Finsbury-pavement, E.C.; J. L. Whitmarsh; R. F. K. Puttiriss, Mile End-road; A. Jackson, 25, Liverpool-street, E.C.; J. Garrie, R. Hawkes, T. H. James. Registered, without articles, February 2nd, 1882, by Mr. G. James, 68, Finsbury-pavement, E.C.

ELECTRIC APPLIANCES MANUFACTURING COMPANY (LIMITED.)—Offices: 14 and 15, St. Swithin's-lane, E.C. Objects: For the manufacturing articles and working patents and inventions connected with electricity. The company has entered into an arrangement for the purchase of the established business in the manufacture of electric appliances now carried on in the city of London by Messrs. H. J. & E. J. Dale, and this includes an undertaking on the part of the vendors to patent and assign to the company a dynamo-machine, &c. Capital £50,000, in 50,000 shares of £1 each. Directors: E. Arthur, Esq., M. C. Despard, Esq., J. D. Massey, Esq., Sir William Smith, Bart. Secretary *pro. tem.*, Walter Dunlop, Esq.

ELECTRIC LIGHT CONSTRUCTION, SUPPLY, AND MAINTENANCE CORPORATION (LIMITED).—The capital of the corporation is £500,000 in 100,000 shares of £5 each, with power to increase. The objects of the corporation is to acquire a right to use, or an interest in any invention, directly or indirectly, connected with electricity and magnetism, particularly in regard to lighting, heating, communicating, &c., and to construct, manufacture, erect, supply, maintain, &c., electric lamps, engines, and other motive power. Registered on the 17th January, 1882.

TELEPHONE SUPPLY COMPANY.—Offices: No. 6, Lombard-street. Objects: To maintain, lay down, carry out, buy, sell, &c., telephones, but not to manufacture them. To manufacture other apparatus in connection therewith, &c. Capital £50,000, in 5,000 shares of £10 each. Registered 10th of January, 1882.